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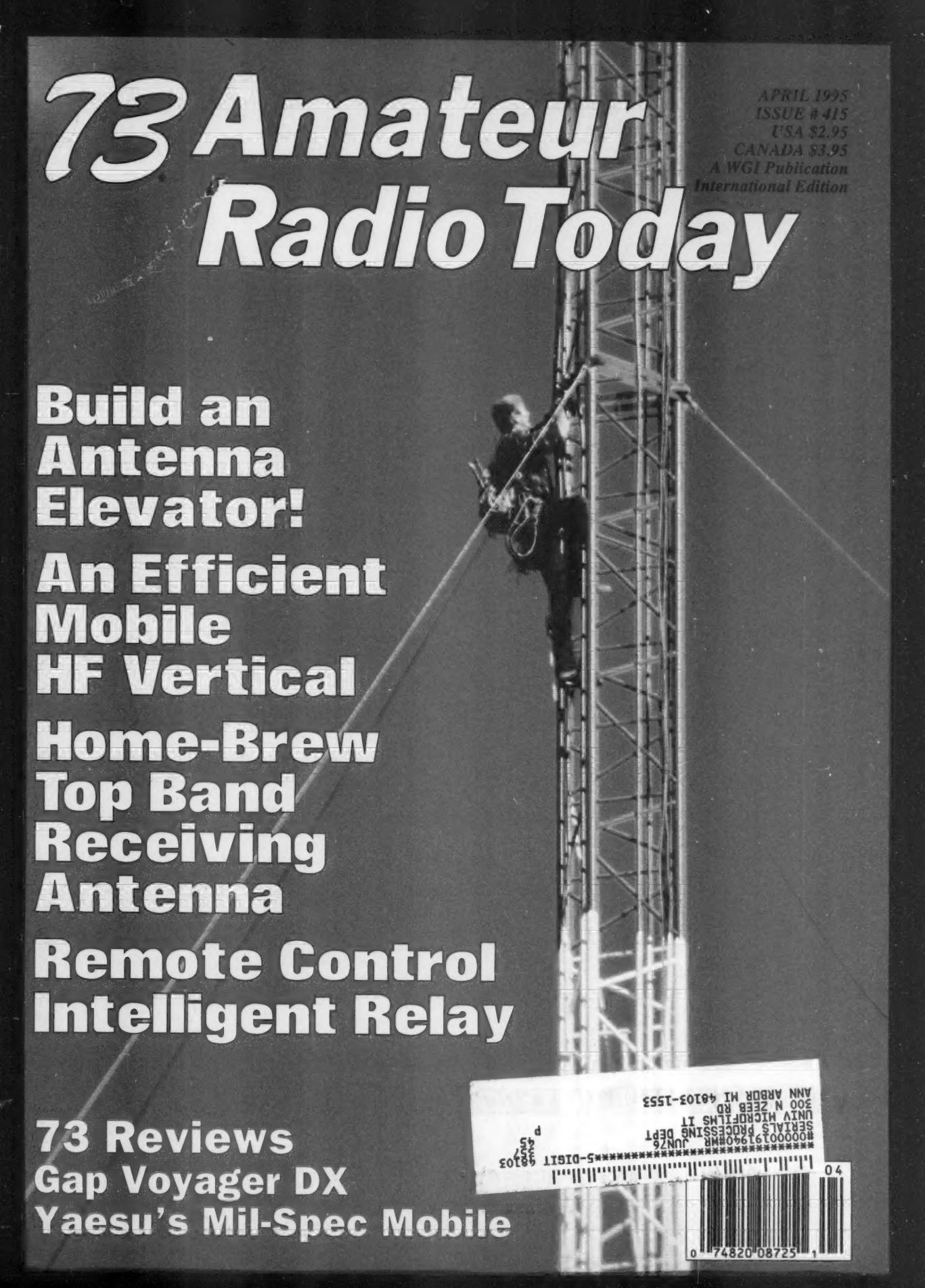

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73 Reviews
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Yaesu's Mil-Spec Mobile

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See where all the Packet users are headed

APRS™ software included with PK-12

AEA PK-12

It is easy to see where Packet users are headed when you take a look at the PK-12, AEA's 1200 bps, VHF/UHF Packet TNC.

The GPS firmware and included Automatic Packet Reporting System (APRS™) software allow you to receive and transmit position information. The PK-12 is GPS, Loran, ARNAV, and ULTIMETER II compatible. If your computer has limited COM ports, get AEA's optional APRS Adapter Cable shown below and connect your GPS receiver and PK-12 to one COM port.

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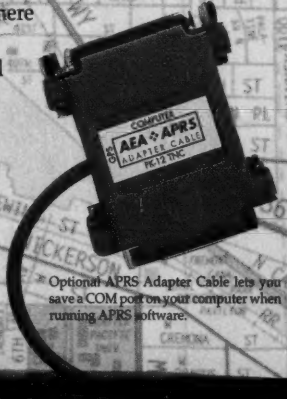
If you're not using the PK-12, where are you headed? Experience the power and value of the PK-12. Call the AEA literature line at (800) 432-8873 for details. See your favorite amateur radio dealer for best pricing.



* Optional APRS Adapter Cable lets you save a COM port on your computer when running APRS software.

AEA

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April 1995
Issue #415

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An infrared view of earth as received at 1200Z on Sunday, 10 July, 1994, off Meteosat 5 as nine separate pictures. The pictures were combined on a Macintosh using Adobe Photoshop. To learn more please turn to "A Practical Weather Satellite Receiving System, Part 2," on page 10.

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FEEDBACK... FEEDBACK!

It's like being there—right here in our offices! How? Just take advantage of our FEEDBACK list on page 17. You'll notice a feedback number at the beginning of each article and column. We'd like you to rate what you read so that we can print what types of things you like best.

On the cover: Antenna work can be a thrill at 300+ feet in the air! Here is a shot of antenna work being done on the W5TSV club repeater tower in Pampa, Texas. A one-year subscription/extension goes to Ken Payton KB5RQV in the 73 Photo Search.

FB

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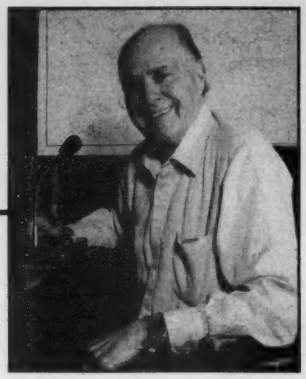
Contract: Read any good books lately? Quit stammering, and turn to Uncle Wayne's Bookshelf on page 94. It's about time for you to start stimulating your gray matter with a good book!

NEVER SAY DIE

Wayne Green W2NSD/1



Mac or PC?

Sherry pointed something out to me that was so obvious that I felt stupid for not noticing. She asked why I'm not running more computer articles in *73*? Hmm. Why indeed? As soon as she asked, it hit me. At the Virginia Beach hamfest over half the exhibitors were selling computer stuff. Even at Dayton the number of computer exhibitors has been growing and growing. And the flea market is packed with computer stuff. Yes, hams are buying computers, drives, software, boards, and parts. They're buying them big time.

I remembered back to 1975, when the first microcomputers came on the market and the enormous interest the ton of computer articles I published in *73* generated. Later I reprinted the articles in a book on computer basics and it sold like gangbusters.

Today I doubt that one ham shack in 50 is completely without a computer. We use 'em for logging, for copying CW, RTTY, slow-scan, packet, AMTOR, ham satellite antenna aiming, and so forth. We use 'em to design circuits, antennas, draw schematics, etc.

Now what all that means is that I want to see a whole lot more articles being submitted on using computers in amateur radio. I want to see them for PCs and Macs. I want construction articles on making boards to help us do our dirty work. And on ways to modify existing boards for amateur applications, or even other things around the home that might at least ingratiate the XYL and make her slightly more tolerant of your hobby.

73 readers are interested in user reports on ham-oriented software and accessory boards, so when you try something new, keep notes. With more stuff appearing on CD-ROMs, such as the *Callbook*, we all want to keep up with anything relevant to our interests on CD-ROMs.

How about converting older computers so they can use current software? Is there any way to update an old TRS-DOS or CPM computer so it can live in a PC environment? Or are all those old computers just boat anchors now? There are hundreds of thousands of them kicking around, so if there's some way to update them we'd have a great supply of cheap computers for our shacks.

How hard is it to upgrade old 8086 PCs to a 386? Or better? Is it practical?

Maybe you could survey the computer exhibits at the next hamfest you attend and send me a report on what you've found that look like bargains, and what you think are rip-offs.

If you get a chance, take a good look at the *73* I/O sections in the mid-'70s and you'll see how much hams were into computers then. Well, it's 20 years later and the only thing that's changed is that hams today have even more interest in computers than they did a generation ago. When a May 1976 issue turned up the other day I checked and found we had 25 pages of computer articles. Plus my page and a half I/O section editorial.

What's That Damned Noise?

It's Opportunity, banging away at your door, so why are you sitting there wasting your time when you could just as well be making money? A ton of money? Of course, I'm probably irritating you about this money thing because you have undoubtedly already organized your life so you are working at a job you really enjoy and making more than enough money to do just about anything you want. However, if this is true, it sure isn't reflected in the mail I'm getting.

I got to thinking about this when I saw two mail order companies selling a product which I'd recommended you think about as a commercial product when I published the schematic and details in an article 19 years ago. Okay, so I was ahead of my time again. This is a great little device which jams police radar signals. And, the best part, it's a device which does this legally!

The article appeared in the Holiday 1976 issue, pages 32-35. In the introduction I explained that this simple unit could be home-built for around $10 and should sell like crazy at $49.95. It's on the market now for $100, which is about the same as $50 twenty years ago.

So what is it that gets some people to think as entrepreneurs, while others just trudge along from day to day, living lives of frustration and "quiet desperation?" The world provides plenty of entertainment to help us while away our lives instead of using our time to make more money and maybe provide some products or services which will help the world to progress. For entrepreneurs, I should put those two benefits in the reverse order.

Articles in the business magazines by writers who have studied entrepreneurs tell us there are some common factors. For one, none of the really successful entrepreneurs have gone into business with the primary goal of making money. They are usually interested in doing something which they feel needs to be done. Sure, they know they have to organize their enterprise so it will make money if they are going to accomplish anything, but that's secondary and a nuisance.

Few successful entrepreneurs bother to finish college. They are too impatient. They discover that they aren't getting a good value for the time they are spending. They figure out that all a college education can really do is provide a basis for future learning. It's only a ticket to learn. It's a ridiculously expensive, time-wasting ticket.

The radar jamming unit is simple. It consists of an antenna tuned to the radar frequency which reflects the radar signal back with a stronger reflection than your car produces. In the antenna is a diode which modulates the reflected signal and fools the police radar unit into indicating whatever speed you want it to indicate. Since there is no transmitter, the device does not require a license and is thus completely legal to use. It's a nice countermeasure.

An entrepreneur would look at the article and see an obvious public need, and thus an opportunity. As I pointed out in the first paragraph of my introduction to the article, " . . . the main reason for publishing this article is that it is an example of applying ham techniques to make commercial products. As a detector of police radar, one which returns a strong echo modulated to indicate whatever speed you wish, it is possible that a *lot* of these could be sold."

It doesn't take a lot of money to start a small manufacturing business. When I decided to start making loudspeakers in 1951 I went to the bank, borrowed $1,000 on my car, and got a small wood shop to make a few units for me. Within two and a half years I had five factories working full-time to fill my orders and I was the largest manufacturer of loudspeakers in the country. In terms of today's dollarettes I was selling about $20 million worth a year. There goes Wayne, bragging again, right? No, it's really not that. I just want to show you that I'm not writing puff and baloney. I've been there, done that. I'm trying to encourage you to do things by proving they can be done because I've done them. Like the time I dieted 20 years ago and took off 85 pounds . . . and have kept it off.

There are endless businesses you can start in your spare time with only a modest investment. But you have to keep your eyes open and your imagination tuned for opportunities. I was lucky in that my mother's father was an inventor. A successful inventor. He's the one who helped Henry L. Dougherty get going in the oil business . . . now known as Citco. He's the one who stepped in and reorganized Continental Can Company with innovative new products during the depression, thus keeping it from going under. It's doing fine today. He was a good role model.

My father was an entrepreneur too. He saw the opportunities in the flying business, so he learned to fly in 1921. He did the usual barnstorming at first, did the first study of American airports for the Department of Commerce, built Central Airport for the Philadelphia area, started the first transatlantic airline, and so on. We're working on reprinting his Ancient Aviator articles from *73* in book form.

My friend Joe Sugarman W9IQO saw an opportunity to sell electronic gadgets to yuppies and made millions with his JS&A mail order operation. He's now doing just fine selling Blu-Blocker glasses via TV infomercials.

Once you tune your mind to it, there are endless entrepreneurial opportunities. I started my first business when I was 13. I was into stamp collecting and I noticed that there was an interest by collectors in buying bulk stamps, so I went into business as the Elm Stamp Company. I bought 100-pound bags of stamps, repackaged them in five- and ten-pound boxes, and built a nice little business. That was just before I got interested in radio at 14, which then took over my time. It still does.

It's frustrating for me to see people wasting their time watching sports, soaps, sitcoms, and on idle gossip on 75m or QSL-hunting on the higher bands. With so many entrepreneurial opportunities out there, why leave little more than a headstone and a few poorly brought up children as your only legacy?

To find opportunities you need to read. There are products and services needed in just about any field you look

Continued on page 82

DR-150T

FULL ACCESS MOVES YOU AHEAD

Engineered for Satisfaction. Alinco's DR-150T sets a new industry standard for 2 meter mobiles, featuring up-to-the-minute technology and a full-powered 50 watts.
So advanced and yet so simple to use, the DR-150T will more than satisfy the needs of beginners and Ham veterans alike.

Channel Scope Sweep Scan

Enjoy visual scanning capability of multiple frequencies along with simultaneous receive audio!!!

While in the channel scope mode, activate the scan function and quickly access only those frequencies that show a strong signal indication. The DR-150T's "S-meter" squelch control has 8 adjustable settings for custom operation. With the DR-150's built-in band scan, program scan and memory scan modes, the radio may be set to stop on either a busy or a vacant channel. Also, the DR-150T gives you a visual display confirming the direction of the scan, a feature which adds to the overall user friendly construction that this rig has to offer.

New Safety Dialer

Alinco has specially designed the DR-150T for mobile-safe operation. The new Safety Dialer feature enables the operator with complete control of auto dial transmissions simply with the equipped remote mic. Depressing the PTT in conjunction with either the up / down buttons gives you simple and direct access preventing any distraction while driving.

Features

- ✻ Frequency Range
- ✻ Receive: 108.000 – 173.995 MHz (AM, FM)
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  Transmit: 144.000 – 147.995 MHz (FM)
- ✻ Power Output
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- ✓ Channel Scope (Visual Search)
- ✻ Various Scan Modes
- ✻ 100 Memory Channels plus 1 Call Channel Memory, 1 Program Scan frequency Memory
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- ✻ S meter Squelch Function
- ✻ Tone Burst Function
- ✻ Built in RF attenuator
- ✻ Built in 9600 bps/Phone Patch Interface
- ✻ Built in Tone Encoder (50 Tones)
- ✓ Safety Dialer (5 memory channels)
- ✻ DSQ Function
- ✻ Direct Frequency Entry from the DTMF microphone
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LETTERS

Number 2 on your Feedback card

From the Ham Shack

Lowell White KA9AMJ, Roanoke TX Wayne, after reading the January 1995 issue I felt it was certainly time to write.

The review of the Yaesu FT-840 was right on! I bought one six months ago as a replacement for an old rig that I'd had and liked a lot.

I consider the FT-840 superior as being DDS rather than PLL, and having a backlit LCD display rather than the impossible-to-read-in-the-sunlight green gas tubes in the old rig. Having more memories in it doesn't hurt, either. The *key* factor in my buying the radio was its ability to store band segments into tunable memories. That allows us mobile HF operators to use the tuning within the memories instead of the VFOs—conveniently keeping us from tuning out of band (or license privilege frequency range) without having to watch the display like a hawk. That's a *major* plus while mobile in city traffic. Unfortunately, even the Yaesu reps at Ham-Comm (Arlington, Texas) weren't aware of the radio having this feature. One specifically said it couldn't do it—though their own literature indicated it could. Hmmm.

The construction article on the 10 meter Pyramid Antenna was good—I may consider building one. I currently have a couple of five-element yagis that will get preference, though. My main desire is for a *good* mobile antenna that is short enough to go into a parking garage and still produce a walloping signal. So far the best antennas seem to be *way* too tall and/or expensive. I've got some ideas so maybe I'll hack at that. Maybe Mr. Bilal (Bilal Company) has an answer.

Best of all in this issue was (as often is the case) your editorial. You are one of the few folks that I can consistently rely on to prod your readers into being *active* in getting something done aside from existing—or at least cognizant that there is more to life.

I have often wondered about gravity waves and related phenomena. It seems that the ability to measure them, let alone the ability to shield/dilute them or enhance them, could be very valuable. Imagine the impact that could be had in the fields of transportation, security, and likely in manufacturing processes, too.

Spread spectrum transmission is an appealing thing, too, especially thinking about how it parallels with the ISDN services the communications and now computer industries are trying to get a handle on. Maybe we need to come up with a better way to make it more accessible for fewer dollars. Maybe use a lesser adaptation to automatically shift transmission frequencies to take advantage of better propagation and save a few watts of power while getting just as good or better transmission quality (fewer resends and better signals).

I have an idea also to maybe offer a competitive service to the now-ineffective patent system. I've learned techniques that our "friends" in foreign markets use to make the patent system work against us (the U.S.). Maybe an alternative system—with appropriate court representation (ugh!) is what's needed. Why not privatize it? Compete with the existing one? As you know, the individual with a brain can outperform the "gummint" any day for efficiency and productivity. Why else do we keep getting charged more for a letter to be mailed more slowly when at the same time it's getting cheaper to connect to the Internet and send pictures, video, sound and text in a matter of seconds (or, at worst, minutes)? I've personally resolved to use the snail mail for increasingly *less* of my correspondence and use E-mail *more*.

Thanks for a great mag. I subscribe to *Radio Fun* also. I like to read through it, get the "news," and have a good sampler to pass on to prospective hams. It's a good recruiting tool.

"Thanks for a great mag. I subscribe to Radio Fun also. I like to read through it, get the 'news,' and have a good sampler to pass on to prospective hams. It's a good recruiting tool."

George M. Crewe VE3TPD, Wheatley, Ontario, Canada Wayne, I have enjoyed your column and your magazine over the years. I have only been licensed for three years but I have been a reader of *73* since I was old enough to read.

My dad was a subscriber to *73* for a year or two back in the '50s. He had always wanted to become a ham but for whatever reason he could never seem to master CW. Being a commercial fisherman and boat builder, he was very busy and lack of time, I guess, was a factor.

After WWII, there was a pile of surplus equipment available and he acquired quite a bit of it with the purpose of building an AM marine band rig for his boat. Advanced theory would not have been his problem as he quickly came up with a converted 19 set to fill the bill. Although as illegal as could be, that rig did the job of adding to the safety of a lot of people for about three years until he finally got a license and a legal rig. When someone was in trouble and needed help, he was one of the first to come to their aid, regardless of the weather.

I still have an old Marconi RCAF transmitter of his which I hope to put on the air on 80 meter CW. I love old equipment. My main HF rig is an old EICO Model 753 (7 drifty 3). I also run an old Galaxy III on 80 meter CW. I have an old Marconi Marcomm II that I stripped the innards out of and converted to CW on 80, 40 and 30 meters. An old Marcomm III fills the bill for some light operation on 160 meter AM phone. To put the whole thing into focus, I spent a lot of time looking over Dad's shoulder as he built those Heathkits and tuned those old Marconis on the boat.

Dad was someone who worked hard all year and when summer came he left his business to those who worked for us and toured the Great Lakes system in his 54-foot cabin cruiser. For six weeks home was anywhere between here and Thunder Bay. Once north of the Soo, radio stations were few and far between. This is where I came to enjoy SWL and broadcast band DXing. During the day the BBC and a number of other SW broadcasters filled the bill. At night it was nothing to pick up stations like WBZ in Boston or WABC in New York. This was a hobby which I had come to enjoy at home and still do today.

Back in 1981, I took a radio-TV servicing course with the National Radio Institute. For the better part of 10 years I serviced TVs and radios part-time. They always told us in school that people never complete correspondence courses. I have two diplomas that say they're wrong. Working full-time as a quality control inspector in a factory and working on the side got a little tiring. Three years ago I decided to get back to enjoying electronics as a hobby and not a job.

Last fall I decided to get back to school again. This time the subject was broadcasting. Back in 1962 the broadcaster and actor Lorne Greene started the National Institute of Broadcasting in Toronto. I am proud to be a graduate of their radio and TV broadcasting course. Last year I had the pleasure of chatting with an old friend of Greene's on 12 meters. He had known Greene for a number of years and it kind of put the icing on the cake. He mentioned the Institute, but was unaware that America's famed "Ben Cartwright" had worked for the CBC for a number of years before moving stateside. The late Mr. Greene had run a commercial promoting amateur radio on CBC television which ran up to a year after his death. His legacy lives on and the broadcasting school that he started is bigger than ever.

In a recent column you mentioned that you were considering producing a talk show on radio. Great stuff! We need all of the public awareness we can get. Radio Havana does it with Arnie Coro, so why not do it over here? I had the pleasure of working Arnie a couple of years ago on 6 meter phone and all of the time I kept wondering where I had heard his voice before. Upon recalling his radio program I remember thinking that I never dreamed I would get to talk to him in person. Ham radio has introduced me to a lot of really neat people.

Kudos on your work with cold fusion. This is something which I believe will forever change the way we live. There are too many people (complacent individuals and willfully ignorant) who continue to say that it can't be done. These are the same type of individuals who said that we would never reach the moon, travel faster than sound, fly, or send messages without wires. It will be done, and it will be done even more efficiently now because of things like the Internet, which enables researchers to access each other's findings and compare notes.

73 for now, and keep on writing.

Dave Horsfall VK2KFU, Wahroonga, NSW, Australia As I write this, Australian amateurs are up in arms over a proposal that will nearly double our license fees—I have never seen so much packet radio traffic! Our annual fee is currently AU$37 (it was $36 last year), and late in December, just before Christmas, the SMA (Spectrum Management Agency) announced that a new charging scheme will be introduced from March 1st, which will have the effect of nearly doubling the fee to $69 or more.

Some peculiar logic (even for public servants) is used to justify this, and it seems the "user pays" principle has finally reached the Amateur Radio Service. There are three components to this new fee: Issue/Re-issue, Spectrum Maintenance Tax, and Spectrum Access Tax. The SMA claims that it costs $140 to first issue a license, and as Amateurs apparently keep their licenses for 10 years this is amortized over that period, which when added to an apparent renewal cost of $11, leads to a re-issue fee of $25. The Spectrum Maintenance Tax is explained (and I quote): *"The Spectrum Maintenance charge is the proportion of costs of the on-going work of the SMA."* We think this means that the sunspots have to be cleaned every so often. The Spectrum Access Tax is based upon the principle of "spectrum denial," which is to say that Amateurs are using frequencies which could be used by other services; a figure of $35 was arrived at by measuring the amount of spectrum allocated to Amateurs (on a sliding scale where UHF is worth more than HF) and dividing it by the number of licensed Amateurs.

I wish this was an April Fool joke, but I am not kidding; the general feeling of Amateurs is that our national body, the Wireless Institute of Australia, has let us down, and Amateurs are being exhorted to write letters to politicians, the media, etc.

Here is some food for thought: Last October, CB fees were dropped entirely, as apparently it was not worth the bother of chasing unlicensed operators; at a then fee of $18 the 358,699 licensed operators (as of June 30th 1993) netted the government a total of $6,456,582. At the same time, the 18,142 licensed Amateurs provided $634,970. Are Amateurs being made to pay the shortfall? 73

You get more features for your dollar with the

REP-200 REPEATER

A fully microprocessor-controlled repeater with autopatch and many versatile dtmf control features at less than you might pay for a bare-bones repeater or controller alone!

Kit $1095; w&t only $1295!

- Available for the 143-174, 213-233, 420-475, 902-928 MHz bands.
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- Color coded LED **status indicators**.

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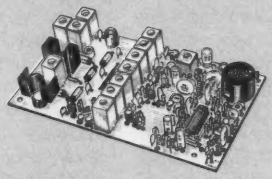

- **TA51**: 50-54, 143-174, 213-233 MHz .....kit $109, w&t $189.
- **TA451**: 420-475 MHz .....kit $109, w&t $189.
- **TA901**: 902-928 MHz, (0.5W out); w&t $219.

VHF & UHF AMPLIFIERS. For fm, ssb, atv. Output levels from 10W to 100W. Several models starting at $99.

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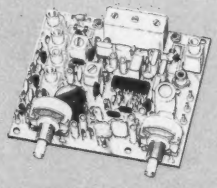

- **R144/R220 FM RECEIVERS** for 143-174 or 213-233 MHz. **Sensitive** front end, 0.18uV, both crystal & ceramic if filters plus **helical resonator** front end for exceptional selectivity: >100dB at ±12kHz (best available anywhere!) Flutter-proof hysteresis squelch; .....kit $149, w&t $219.
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- We also have preamps and receiving converters for 137 MHz, and we carry the *Weather Satellite Handbook* by Ralph Taggart.

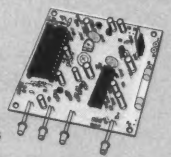
ACCESSORIES

COR-3 REPEATER CONTROLLER. Features adjustable tail and time-out timers, solid-state relay, courtesy beep, and local speaker amplifier. .....kit $49

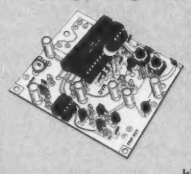
CWID. Diode programmable any time in the field, adjustable tone, speed, and timer. .....kit $59

COR-4. Complete **COR and CWID** all on one board. CMOS logic for low power consumption. EPROM programmed; specify call. .....kit $99, w&t $159

NEW **COR-6. COR & Real Voice ID** on one board. Digital ic records up to 20 seconds of your voice. Can record multiple id messages. Tail and time-out timers, courtesy beep, solid-state relay to key transmitter. kit $99, w&t $149



Versatile DVR-1 DIGITAL VOICE RECORDER Module. As a **voice ID'er for repeaters**, records your voice, using the built-in microphone or external mic. Just the thing for **fox hunt** xmtr id! May also be used as a **contest caller** to play back one or more messages through your transmitter at the press of a switch. Used as a **radio notepad**, it can record the audio output of a receiver — up to 20 sec. of anything you might want to recall later. Play back as often as you like through a small external speaker. Extensive manual tells how to use multiple messages and adapt to many applications. .....kit $59, w&t $99



TD-4 SELECTIVE CALLING Module. Versatile dtmf controller with 1 latching output. Mutes speaker until someone calls by sending your 4-digit tt code. Or use it with a long tt zero digit to alert anyone in club. Also may be used to control autopatch or other single device. .....kit $49, w&t $79

TD-2 DTMF DECODER/CONTROLLER. 16 digits, programmable, toll-call restrictor. Can turn 5 functions on/off. .....kit $89, wired & tested $149

AP-3 AUTOPATCH. Use with TD-2 for repeater autopatch. Reverse patch and phone line remote control are std. .....kit $89, wired & tested $149

AP-2 SIMPLEX AUTOPATCH Timing Board. Use with above for simplex operation using a transceiver .....kit $39

TD-3 SUBAUDIBLE TONE DECODER/ENCODER. Adjustable for any tone. **Especially for repeaters,** with remote control activate/deactivate provisions .....kit $29, wired & tested $59

DATA MODEMS

MO-202 FSK DATA MODULATOR & DE-202 FSK DEMODULATOR. Run up to 1200 baud digital signals through any fm transmitter & receiver. Radio-link computers, telemetry, etc. .....kit ea $49, w&t ea $79

9600 BAUD DIGITAL RF LINKS. **Low-cost** packet networking system, consisting of MO-96 Modem and special versions of our 144, 220, or 450MHz FM Transmitters and Receivers. Interface directly with most TNC's. Fast, diode-switched PA's output 15 or 50W. CALL.

Low Cost GaAsFET PREAMPS

LNG-(*)

ONLY $59 **wired&tested**

FEATURES:

- **Very low noise:** 0.7dB vhf, 0.8dB uhf
- **High gain:** 13-20dB, depends on freq
- **Wide dynamic range** - resist overload
- **Stable:** low-feedback dual-gate FET

**Specify tuning range: 26-30, 46-56, 137-152, 152-172, 210-230, 400-470, 800-960 MHz.*

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ONLY $29 kit, $44 wired&tested

- GaAs FET Preamp similar to LNG, except designed for **low cost & small size.** Only 5/8"W x 1-5/8"L x 3/4"H. Easily mounts in many radios.

**Specify tuning range: 25-35, 35-55, 55-90, 90-120, 120-150, 150-200, 200-270, 400-500 MHz.*

LNS-(*) IN-LINE PREAMP

ONLY $89 kit, $119 **wired&tested**

- GaAs FET Preamp with features similar to LNG series, except **automatically switches out of line during transmit.** Use with base or mobile transceivers up to 25W. Tower mounting brackets incl.

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GaAs FET preamps with helical resonators **reduce intermod & cross-band interference** in critical applications. **MODEL HRG-(*), *$80 vhf, $110 uhf.***

**Specify tuning range: 142-150, 150-162, 162-174, 213-233, 420-470.*

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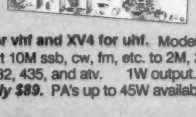
Low noise converters to receive vhf and uhf bands on a 10M receiver.

- Input ranges avail: 50-52, 136-138, 144-146, 145-147, 146-148, 220-222, 222-224 MHz, 432-434, 435-437, 435.5-437.5, and 439.25 (to chan 3).
- **Kit less case *$49*, kit w/case & BNC jacks *$74*, w&t in case *$99*.**

TRANSMITTING CONVERTERS



XV2 for vhf and XV4 for uhf. Models to convert 10M ssb, cw, fm, etc. to 2M, 220, 222, 432, 435, and atv. 1W output. ***Kit only $89.*** PA's up to 45W available.

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FCC Releases Vanity Rules

The Federal Communications Commission has released the details of its plan to implement so-called vanity callsigns to radio amateurs. The commission's new computer system will continue to assign call letters in the traditional consecutive sequence; however, soon the FCC will be able to accommodate those who desire a callsign of their own choosing according to a system of four starting gates:

Gate one would allow a previous holder of a callsign to apply for that callsign, or if the holder is deceased, a relative could apply.

Gate two would allow the 66,000 Amateur Extra Class operators, having passed the most difficult of amateur exams, to apply.

Gate three would allow the 112,000 Advanced Class operators, having passed the second most difficult exam, to apply.

Gate four would open the system to any licensee, including a club station license trustee, to apply for the callsign of a deceased former holder.

The FCC is expected to announce the opening of each gate by means of a public notice. First, the commission must prepare the new application—Form 610-V. The Notice of Proposed Rulemaking for the personalized calls was adopted way back on December 13, 1993. A fee is expected to be charged for the privilege of holding a vanity callsign. *TNX W5YI Report, Feb. 1, 1995.*

Emergency Center To Link Ham Radio With Internet

Plans for what organizers call "the world's first public emergency communications center" have been announced by a Colorado amateur. John Hart NØOCF of Lakewood, Colorado, says he is starting the "E-COMM" communications center as a non-profit organization to link amateur radio with the Internet worldwide to expedite emergency communications among disaster victims, family, and friends.

"The concept of E-COMM is simple," Hart said. "If you are in a city where disaster strikes, or if you are experiencing an individual emergency, E-COMM will pass a health and welfare message, anytime day or night, to your family and friends, wherever they reside, even if phones are down and power is out . . ."

Getting a message to E-COMM is accomplished in cooperation with ARES, the Amateur Radio Emergency Service. The new emergency center plans to form a strategic alliance with ARES operators and groups. Those operators and groups are expected to be listed in city directories and other databases.

The new communications center to be built in Lakewood, Colorado, will include HF, VHF, satellite, packet, an e-mail server, an ftp server, and a WWW server all connected to the Internet. For more information you can contact founder John Hart directly at *E-COMM, Inc., 767 South Xenon Court, Suite 117, Lakewood, CO 80228; (303) 987-3246, FAX (303) 987-3246, or Internet: jhart@teal.csn.net.*

Mighty Microwaves From Denmark

According to Steen OZ9ZI, it was a surprise to learn after the Danish Microwave Activity Week 1993 that what they thought was a world record on 145 GHz had been broken almost before it had been set. The aim was to set a new record in the course of the D. M. A. Week 1994 but the weather did not permit this. Therefore, a decision was made to attempt the new record as soon as the weather improved.

Organizers selected a distance of 11 km over Arreso, which had been previously used for the first 10 GHz tests back in 1983. A talk back frequency of 47 GHz was eventually agreed upon.

The SSB QSO was carried out on 02-07-94 at 16:30 GMT with a 5-6 / 5-7 report. Stability was surprisingly great—the frequency difference was only 146 kHz in relation to the estimated difference, and the frequency drift was acceptable.

The following equipment was used for this feat: DB6NT's 12 GHz injection chain and doubler/amplifier (12/24 GHz) and a double-balanced harmonic mixer with four Russian-made diodes. Transmitter output was -7 and -9 dBm, the receiver noise figure 13 dB. The aerials are 25 cm Procom dishes with a backfire feed system. According to OZ1UM's calculations, these stations should be able to transmit 60 kM! *TNX OZ9ZI.*

Thailand Celebrates Communications

On 4 August, 1994, Thailand celebrated its National Communications Day. The theme of this year's celebration, "Communications for a better life of the Thai people," was celebrated by speeches, tributes, an exhibition, a two-day seminar—attended by both local and foreign participants—the issuance of commemorative stamps, first day cover and the distribution of commemorative books. *TNX Newsletter of the ITU.*

Japanese Amateurs Help Earthquake Victims

According to the ARRL as reported in the *Ham Arundel News,* more than 200 hams were key contributors to emergency communications in earthquake ravaged Kobe, Japan recently. On January 16, the major temblor shook Kobe's metropolitan area, killing more than five thousand and leaving tens of thousands homeless.

Amateurs and their radio stations have been instrumental in connecting relief centers and providing information on road conditions and traffic, health and welfare, and the availability of food and water. Hams have also been key in helping residents locate missing loved ones.

Some two hundred handhelds were provided in cooperation with the Japanese Amateur Radio League and the Japan Amateur Radio Equipment Industry, at the request of the Ministry of Posts and Telecommunications. In addition to the 430 and 1260 MHz HTs, three repeater stations were supplied by JAIA member companies for the rescue operation. *TNX ARRL: The Ham Arundel News, February, 1995.*

A look at the 145 GHz equipment used to set a new world distance record. (See text.)

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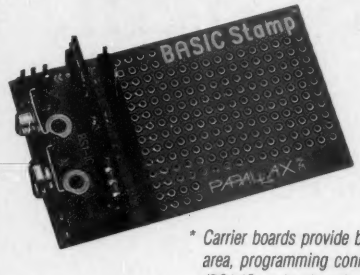
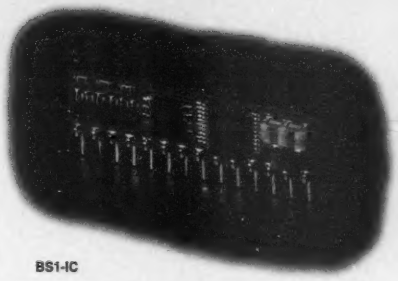
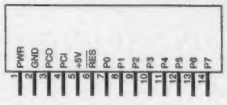
Stamp-sized modules run BASIC



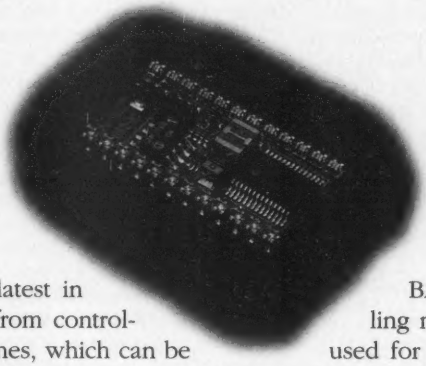
BASIC Stamp I Module (BS1-IC)
8 general-purpose I/O lines
256-byte program space (100 instructions)
4-MHz clock (2400 baud serial, etc.)
$29, $39 with carrier board*



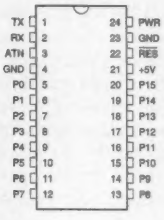
BS1-IC



* *Carrier boards provide battery clips, prototyping area, programming connector, and reset button (BS1-IC carrier shown).*



BS2-IC



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These new BASIC Stamp modules are the latest in BASIC Stamp computers. They're perfect for numerous applications, from controlling model trains to monitoring factory sensors. They have 8 or 16 I/O lines, which can be used for a variety of digital and analog purposes. And like the original BASIC Stamp, these modules are programmed in BASIC. Our special "PBASIC" language includes familiar instructions, such as GOTO, FOR...NEXT, and IF...THEN, as well as SBC instructions for serial I/O, pulse measurement, and button debounce.

The BASIC Stamp Programming Package contains everything you need to program Stamps using your PC. The package includes our editor software, programming cables, manuals, application notes, and free technical support. The package is available for $99; Stamps must be purchased separately.

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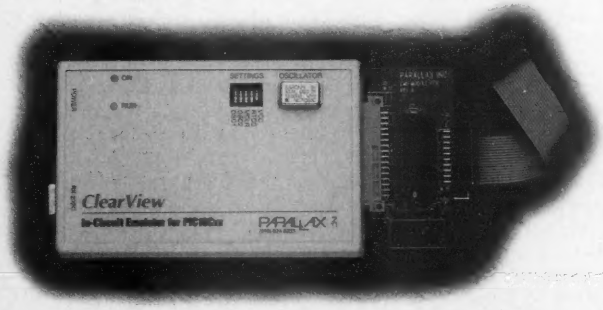

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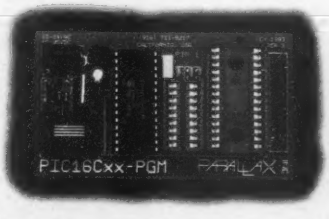

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A Practical Weather Satellite Receiving System, Part 2

Software and interfacing with the PC.

by Angus Anderson ZR6UM

Last month we covered the setting up of a weather satellite receiving and decoding system for polar orbiting satellites, the pictures from which can be displayed on a PC using a shareware package called JVFAX 6.0. Part 1 covered the antenna, preamp and receiver requirements, and the decoder unit.

This month we will cover the parallel I/O card to link the decoder to the PC, PC requirements, and the JVFAX 6.0 display software.

Weather Satellite Display Systems—A History

I remember seeing, in 1965, a hardware design from Fairchild for a 2400 Hz timebase divider. It used, can you believe it, gas discharge tubes to provide the numeric division to divide the 2400 Hz satellite signal to 0.5 Hz for synchronizing the early TIROS satellite signals. Have we ever come a long way since then!

Early display systems included direct exposure of scan lines from a CRT onto a camera, a line at a time. The camera shutter was held open for the duration of a satellite pass, where the variable intensity "flying spot" traversed a (preferably large) CRT side to side, top to bottom, thus integrating the picture onto film. The shutter was then closed, and the film developed to get a picture. Excellent results were possible with careful adjustment, but the system was slow, clumsy, and one could never see the picture in real time to make adjustments. Anyway, how many of us have access to darkroom equipment?

Later systems included fax-type printers that exposed photosensitive or electrosensitive film attached to a rotating drum, the speed of which was synchronized to the spacecraft horizontal line rate. The *optical* assembly was attached to a traveling horizontal lead screw, which traversed the paper incrementally, synchronized to the spacecraft vertical line rate. Using a modulated and focused light source, it would focus a dot onto photosensitive paper to produce the image. The other method used a current-driven stylus resting on electro-sensitive (conductive) paper, which burnt off the white outer coating, exposing the black undercoating, much like the way our current fax machines work. Varying the stylus current gave a good approximation of gray scale. An audio tape recorder was usually used to store received pictures for later playout, but archival picture quality was very dependent on tape quality and the way the audio tape recorder was maintained.

With the advent of microprocessor-based integrated circuitry, such pictures can be received and stored digitally, and permanently stored on hard disks or floppies, with absolutely no degradation of picture quality. Suddenly, the limiting factor on displayed quality is in the speed of the microprocessor (can it capture hi-res pictures fast enough?), the amount of digital storage available (for hi-res pictures you need lots of disk storage space), and not least, the video display system used.

Display Systems

One of the interesting things about digitally-based weather satellite displays has always been the trade-off between spatial resolution (the number of pixels per line able to be displayed on the screen) and the number of gray scales displayed. The two are directly related because multiplying one (the number of bytes per pixel) by the other (the number of pixels per line) gives the total storage requirements per picture (see below). Matjaz Vidmar YU3UMV states in his 1982 article in *VHF Communications* that he considers radiometric resolution (the number of gray scales displayed) to be far more important than the spatial resolution (the number of dots per line). In other words, if you have to make the choice in a trade-off, it is better to display more gray scales than more dots per line. I agree. In my experience, the absolute minimum number of gray scales for an acceptable picture quality is 16. Below this, you lose detail fast. I consider the absolute minimum number of pixels per line that can be displayed horizontally to be 256; again, below this you lose detail. Since the number of gray scales and the number of pixels have a direct relationship to memory storage required in a PC, usually some compromise has to be reached. For instance, 256 pixels per line at 4 bits (16 gray scales) will allow information for two pixels to be stored in a single 8-bit memory byte. In a 256-pixel line x 16 gray scale picture x 256-line picture, the number of bytes of memory storage needed is (256x256)/2, or only 32K of memory. If you consider the other end of the scale, a picture of 1024x800 pixels, a GOES picture at full resolution of 8 bits per pixel (256 gray scales), will need nearly 820K of memory per picture!

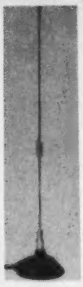
The original display system I built was the design from Matjaz Viroslav YU3UMV. This gave a 256-pixel x 256-line display, with 64 gray scales displayed on a black and white TV monitor. This hardware labor of love had about 60 TTL and DRAM chips on three PC boards, with 64K of dynamic memory and took a long time to debug and get working. Although picture quality was very acceptable, the system could only save to audio tape, and pictures could not be manipulated or printed at all after reception. In its day (11 years ago), it represented the state of the art. Systems that were affordable to the amateur stayed with the old technology until fairly recently, until PC hardware and software "came of age." I still use the YU3UMV system as a second display—and it works fine!

The PC Solution

Almost everyone has a personal computer of some sort at home. Many of these are based on the IBM PC. With the current price wars raging in the marketplace, prices of PCs have come plummeting down, and one can now buy systems that are excellent value for the money. For those of you who don't own a PC system, perhaps now is the time to invest!

With the correct programming, the PC offers flexibility in displaying, manipulating, printing, and saving pictures that hardware-based solutions just can't offer. Because the system is software-based, any upgrade is relatively cheap; you don't have to modify hardware, you just plug in another program or upgrade. The recent decrease in price of VGA display systems allows the display of 256 gray levels on a monochrome monitor. In these systems, 1024x768 display pixels is usual; this makes possible really sophisticated display systems at affordable prices. Such

MFJ Dual Band Mobile Antenna



For an incredible $14.95, you get a dual band 2 Meter/440 MHz mobile antenna with strong magnet mount, stainless steel radiator, 15 feet of coax and BNC adapter for your handheld -- It's the fastest selling mobile antenna in ham radio!

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It's the fastest selling mobile antenna in ham radio!

You get excellent gain for solid, noise-free QSOs. On 440 MHz, it's a high gain ½ wave over ¼ wave radiator. On 2 Meters, it's a *full size* ¼ wave radiator.

Its tough *stainless steel* radiator is only 19 inches tall -- won't knock off when parking in your garage.

An extra powerful magnet holds it steady -- even at highway speeds.

You get 15 feet of coax with a standard PL-259 coax connector for your mobile rig.

You get a BNC adapter so you can also use it with your handheld!

Your MFJ-1724B is protected by MFJ's famous one year *No Matter What*™ unconditional guarantee.

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MFJ-1754 **$24.95** *New!*

Dual band ground plane antenna for 2 Meters and 440 MHz gives you extra long range on 440 MHz with a high gain halfwave over quarter wave radiator. On 2 Meters you get solid quarter wave performance. Mounts on 1 to 1½ inch mast with single U-bolt. Easy-to-tune.

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MFJ-1740 **$12.95**

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You get easy tuning, low loss ceramic antenna insulator and strong lightweight aluminum construction.

Single U-bolt mounting for 1 to 1½ inch mast. Cutting chart included for 220/440 MHz. Made in USA.

MFJ Pocket Roll-Up™

2 Meter halfwave J-pole antenna

MFJ-1730 **$14.95**

Roll up this *halfwave* 2M J-pole antenna and stick it in your pocket! It's the perfect *gain* antenna for traveling.

Get home station performance on the go. Just hang your *MFJ Pocket Roll-Up*™ in the clear and plug the BNC connector into your handheld.

It's omni-directional and has significant gain over a ¼ wave. It does not need a cumbersome ground plane so it's convenient for indoors and works great with handhelds. Made in USA

Dual Band *flexible* Ducks

144/440 MHz flexible ducks for HTs

A. *High Gain FlexiDuck*™, **MFJ-1717, $19.95.** Enjoy dependable QSOs when other rubber ducks give you noise. High gain ½ wave on 440 MHz, full size ¼ wave on 2M. Won't jab you -- bends, twists, flexes with you. 15¾ inches.

B. *FlexiDuck*™, **MFJ-1716,** A. B. **$16.95.** Similar to MFJ-1717. Full ¼ wave on 440 MHz, efficient loaded ¼ wave on 2 Meters. 8¾ inches.

Shorty Duck™ for HTs

Add this *short*, 4¼ inch *ShortyDuck*™ to your 2M handheld for a Q-5 signal! Impedance matched for maximum gain. High-Q helical wound radiator.

MFJ-1718 **$12.95**

5/8 Wave 2 Meter Mobile Antenna

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For *maximum range* while mobile, use MFJ's *Maximum Gain*™ 5/8 Wave 2 Meter Mobile Antenna. You'll get the maximum possible gain of any single element mobile antenna!

Competitive 5/8 wave mobile antennas can't work any better -- no matter how much more they cost.

You get low SWR so your rig can safely deliver maximum power into your antenna. It's rated at 300 watts PEP so you can use any mobile rig plus a mobile amplifier.

You get a heavy-duty magnet mount that holds your antenna tight at highway speeds and a black magnet base that'll look good for years.

You get a stainless steel radiator that'll endure years of harsh mobile use and 12 feet of coax cable.

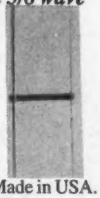
You get MFJ's one year *No Matter What*™ unconditional guarantee.

Order MFJ-1728 with standard PL-259 coax connector or MFJ-1728B that also includes a BNC adapter for your handheld.

Stacked 5/8 Wave for 2 Meters

gives twice the omni-directional gain of a single 5/8 wave

MFJ-1764 **$34.95**



MFJ's stacked 5/8 wave radiators give you *more than twice* the *omni-directional* gain of a single 5/8 wave radiator!

Wide 10 MHz 2:1 SWR bandwidth . . . excellent ferrite choke balun feedline decoupling . . . shunt choke for bleeding off unwanted static . . . strong lightweight aluminum.

Fully assembled -- simply attach radiators -- no tuning required. Mounts vertically for FM/Packet or horizontally for SSB. Installs with single U-bolt on 1 to 1½ inch mast or tower leg. 1½ lbs., two 47 inch radiators, 23 inch boom. Made in USA.

Also works as excellent *6 Meter* full halfwave centerfed antenna.

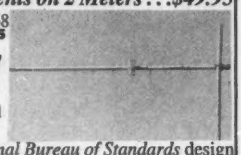
MFJ-1766, $89.95, gives you *four times* the gain of single 5/8 wave. Includes 2 MFJ-1764, phasing cables. Doubles gain on 6 Meters.

MFJ-1765, $29.95, phasing cables for 2 MFJ-1764s, other 2M ant.

MFJ dual band 144/440 MHz Yagi

5 elements on 440 MHz . . . 4 elements on 2 Meters . . . $49.95

MFJ-1768 **$49.95** *New!*



Get two Yagis for the price of one . . . enjoy two Yagis in the space of one with single coax feed!

MFJ's *exclusive* dual band balanced feed with *FerriteChoke*™ decoupling prevents pattern skewing and gives you low SWR.

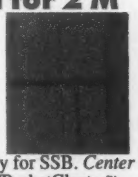
The MFJ-1768 is based on the *National Bureau of Standards* design that's optimized for maximum forward gain with high front-to-back ratio and a clean symmetrical pattern.

Mounts vertically for FM/Packet or horizontally for SSB with single included U-bolt on 1 to 1½ inch mast or tower leg.

High strength 6061-T6 aluminum 5 foot, 1⅛ inch diameter boom. 2 pounds. Elements are electrically isolated from boom. Made in USA.

Portable 3 element Yagi for 2 M

MFJ-1763 **$39.95**



You can set up or take down MFJ's *portable* 3 elements 2 Meter Yagi in seconds! Elements simply screw into the boom.

You can take it with you wherever you go and have the "oomph" and directivity of a beam.

It's easy to store and sturdy enough to use as your home station antenna.

Mounts vertically for FM/packet or horizontally for SSB. *Center* or *end* mounts with single U-bolt. Great for packet/PacketCluster™.

It's compact 2¾ foot boom gives you a calculated gain within 1 dB of a four element Yagi with a boom nearly twice as long.

Extra thick elements maintain high gain and directivity over entire 2 Meter band. MFJ's *FerriteChoke*™ decouples feedline.

Elements and boom are made from strong lightweight aluminum and protected by MFJ's *Permanent Molecular Bonding Technology*™.

Weighs just 2 pounds. Boom is 30½ inches. Made in USA.

5/8 Wave Ground Plane

MFJ-1750 **$19.95**

For a low, low $19.95, you get a *high performance* 2 Meter 5/8 wave ground plane home station antenna -- you'll get the maximum gain of any single element antenna.

More expensive 5/8 wave ground planes can't work any better -- no matter how much they cost.

You get . . . shunt fed matching that bleeds off unwanted static and gives you low SWR . . . strong lightweight aluminum construction . . . low loss ceramic antenna insulator . . . MFJ's *RapidTune*™ radiator . . . MFJ's one year *No Matter What*™ guarantee. It mounts on 1 to 1½ inch mast with single U-bolt and is Made in USA.

MFJ-1752, $19.95, for 220 MHz .

HT Range Extenders

Telescoping antennas for handhelds

A. B. C.

A. *Long Ranger*™ 2 Meter Halfwave, **MFJ-1714**, $16.95. For really long range this MFJ endfed halfwave is hard to beat. It outperforms a ⅝ wave on a handheld because the ⅝ wave needs a ground plane. The MFJ halfwave doesn't. It's shorter, lighter, has more gain and places less stress on your antenna connector than a ⅝ wave antenna. When collapsed, it performs like a rubber duck. 40" extended, 10½" collapsed.

B. *Dual Bander*™ for 2 Meters and 440 MHz, **MFJ-1712**, $14.95. Got a new dual band handheld or separate units? One antenna fits all. It's a ¼ wave for 2 Meters and a ⅝ wave with gain for 440 MHz. 7¼" collapsed, 19" extended.

C. *Pocket Linear*™ ⅜ Wave, 2 Meters, **MFJ-1710,** $9.95. Carry this pen size antenna in your pocket like a ballpoint pen. When you're using your rubber duck, on the fringe and noisy, put on the *Pocket Linear*™, extend it to 24½" and carry on your QSO. Has pocket clip. 5¼" collapsed.

144/440 MHz Duplexer

MFJ-916 **$29.95**

Lets you use dual band 144/440 MHz antenna with separate transceivers *or* separate 144/440 MHz antennas with dual band transceiver.

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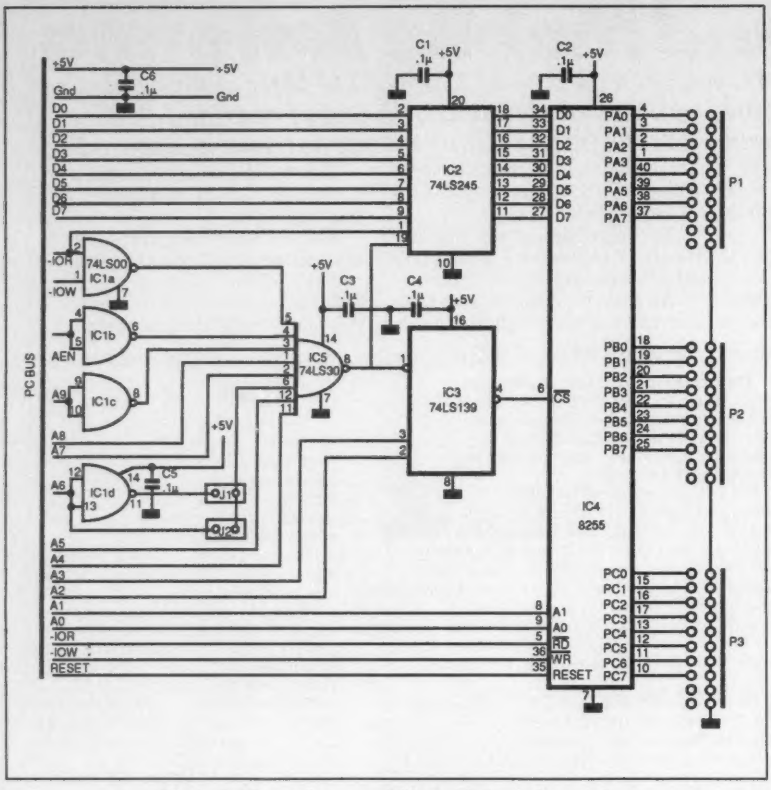


Figure 1. Circuit diagram of the parallel interface card.

systems can store satellite data at the theoretical maximum resolution possible. JVFAX 6.0 is capable of doing this.

Hardware Requirements for the JVFAX 6.0 Software

Minimum requirements are a PC XT or AT, with a minimum of 640K of memory, a hard disk drive of 20 Mb or more, and a 5-1/4" 1.2 Mb or 3-1/2" drive. A Hercules, CGA, EGA, or VGA display will work. I must say that results using other than EGA or VGA are marginal. If you have more than 640K of RAM, use the HIMEM.SYS utility so that JVFAX 6.0 will recognize the extra memory. This is useful for the movie option and the q(uick) save option (see below).

Preferred: A fast 286 (min 16 MHz clock), or a 386/486 with a minimum of 2 Mb RAM, VGA mono or color monitor. A VGA display controller with Trident, Tseng, Genoa, Paradise, Video 7, or VESA compatible chipset is preferred. All these controllers should be able to display SVGA 16 to 256 gray scale mode. For this mode, you should have at least 1 Mb of video memory on your display card. If you are rich or lucky enough to own one of the super super VGA controllers, you can store and display 1024 x 768 x 256 gray scales for superb results.

However, the standard VGA display mode of 640x480x16 gray scales (or colors) on a standard VGA card is very acceptable, as JVFAX 6.0 "dithers" the 16 gray levels to display an effective 64 gray levels on screen. Remember, what is stored in memory and what is displayed can be different. For instance, you might elect to store pictures at 800x800x256 gray scales, but you might only be able to display at 640x480x64 resolution. However, if you elect to magnify the picture, you will achieve far better results if you save at the higher resolutions.

A word about monitors: If you are upgrading to a VGA monitor, there are very cheap VGA black and white monitors available right now that offer superb value; they display 256 gray scales beautifully. In South Africa, the street price right now for a 14" B/W VGA monitor is under $100, a good value.

The PC Interface

The 8-bit parallel video signal from the decoder described in last month's article is fed to a plug-in parallel I/O card. This card contains an 8255 peripheral interface adapter chip, and a variety of common TTL chips that do the address decoding and data buffering. Figure 1 shows the circuit diagram of this parallel interface card. IC1 is a 74LS00 that, together with IC5, a 74LS30, decodes either address 1B0 (Hex) or 1F0 (hex), depending on where jumpers J1 and J2 are set. I usually use address 1B0. IC2, a 74LS245 buffers the data when writing to the PC data bus. IC3, a 74LS139, is an address selector. IC4 is an 8255 IC, which can be programmed so that any of 24 output lines can be set as an input or output. We will be using the PA0-PA7 lines as inputs. We have the advantage that the 8255 on power-up initializes its registers to bring up PA0 to PA7 as input lines, so the line direction control registers do not need to be set first. In other words, when you switch on, PA0-PA7 are ready to accept TTL inputs, perfect for our application. The two other ports can be used as control lines for other applications, if you are prepared to put a bit of programming into it.

The data and control registers of the 8255 are:

$1B0: Port 1a Read/Write buffer
$1B1: Port 1b Read/Write buffer
$1B2: Port 1c Read/Write buffer
$1B3: Port 1 Control register

We are only required to place data into port $1B0 from the decoder; the computer reads from address 1B0 whenever it needs to fetch a pixel value from 0 to 255. You can of course use ports $1B1 or $1B2 if you wish to. I happen to use port $1B1, or port 1b (PA1 to PA7). If you set the card to $1F0, then addresses run from $1F0 to $1F3.

If you wish to program the other ports, I strongly suggest that you get the programming data sheets on the 8255 from your friendly chip supplier. Setting bits on port $1B3 will program the three ports for input or output.

Building the Interface

This is pretty straightforward if you follow the component overlay in Figure 2(a). I strongly suggest that you follow the procedure of first checking for shorts on the power lines with an ohmmeter, plugging in the board, then checking for correct voltages on the power supply pins on all ICUs (+5V) at the sockets. Only then should you plug in your ICUs. The overlay plainly shows the orientation of the IC sockets and the ICUs—notches on the ICUs are plainly visible. Some ICUs have a dot at pin 1.

On this PCB overlay, only the traces on the component side are shown for clarity, since this is a double-sided board. If you elect to make your own PCB, remember to buy high profile sockets so that you can reach the socket pins on the component side, as you will have to solder all pads on both sides of the PCB. You will also have to stake through all feedthrough pads with off-cut wire. The kit PCB is plated through, so you will only have to solder one side.

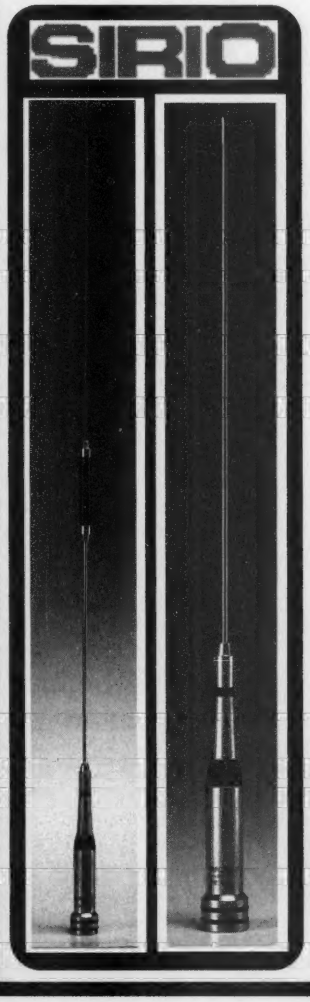
Testing the Interface

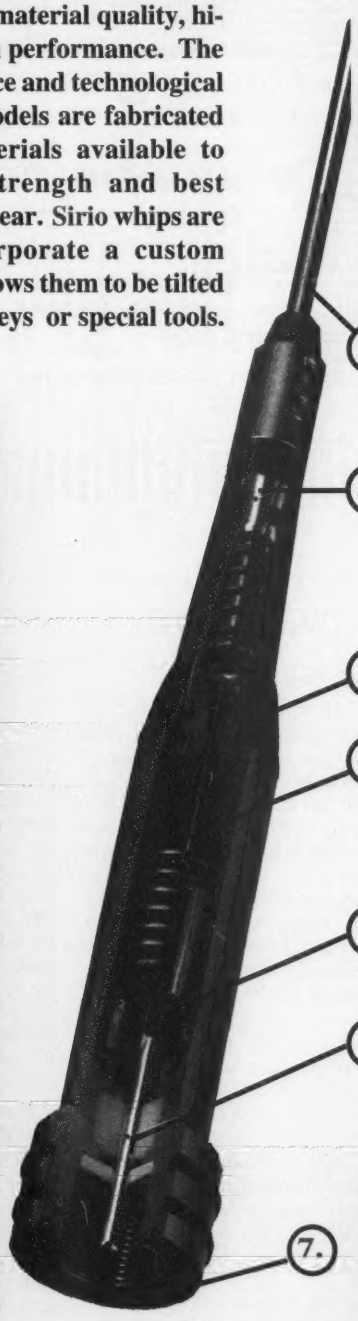
Using GW BASIC, enter and run the following simple program. First select port PA0, PA1, or PA2 for testing when requested. We will use only port PA0 for our project. Use a voltmeter to check for 0V on each line when prompted, and for 5V on each line when prompted to enter the bit number. Measure on the appropriate 8255 IC pins by referring to the circuit diagram. Make sure that you use a sharp-pointed probe so that you do not bridge IC pins when measuring.

SIRIO
Antennas

Sirio has designed the new HI PERFORMANCE line for the discriminating Radio Amateur. These antennas are the very best available in terms of material quality, hi-tech design and maximum performance. The result of years of experience and technological research by Sirio! All models are fabricated with the very best materials available to guarantee maximum strength and best performance. Year after year. Sirio whips are very flexible and incorporate a custom inclination system that allows them to be tilted to 90° without the use of keys or special tools.

An innovative approach has been taken in the construction of the base impedance matching transformers. This new process results in very high and previously unattainable unit to unit precision. Particular attention has also been paid to the UHF male antenna mounting connector which uses a gold-plated center pin, "TEFLON®" insulation and a rubber weather seal for hi-performance and protection from the elements. All Sirio HP Antennas are factory adjusted and no additional tuning is normally required.





1. **Hi Quality 17/7PH stainless steel whip.**
2. **Tiltable section with rubber gasket and stainless steel retention spring**
3. **Dielectric low-loss "ZYTEL" insulator with brass insert soldered at the coil**
4. **High "Q" air wound coil for low dielectric loss**
5. **High voltage ceramic capacitor for a perfect impedance matching**
6. **Gold plated brass center pin with low dielectric loss "TEFLON insulator**
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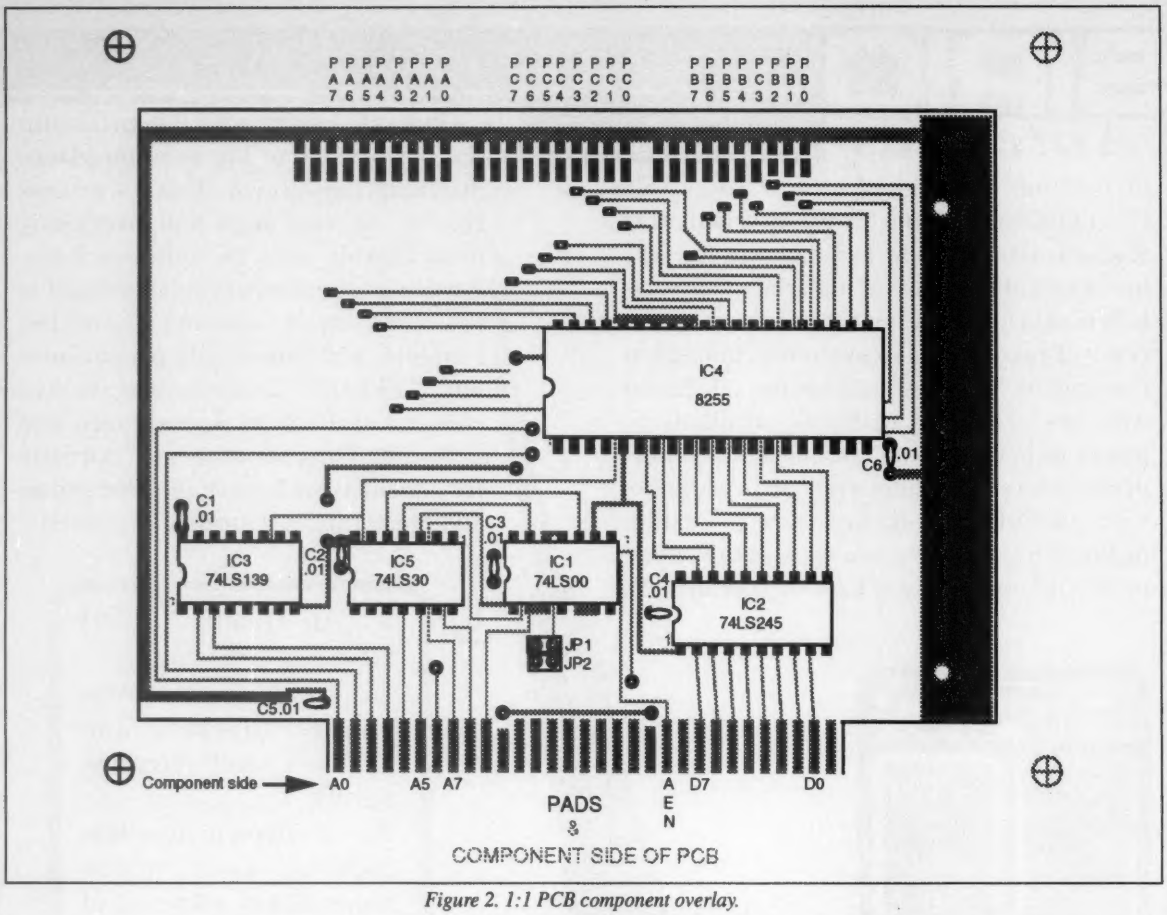

Figure 2. 1:1 PCB component overlay.

```
10 REM Test 8255 I/O lines
20 CLS
30 INPUT"Select 8255 port 0,1, or
2";PN
40 PRINT
50 PORT=&H1B0
60 OUT PORT+3,&H80:'SET PORTS 0,1,&2
AS OUTPUTS
70 OUT PORT+PN,0:'SET SELECTED PORT
LINES TO 0
80 PRINT" Physically check with a
voltmeter that all lines on port
";PN;" are 0V"
90 PRINT
100 INPUT " Hit enter when
done...";ANS$
110 CLS
130 INPUT "Enter bit number to set
high(0-7)";NUM
140 OUT PORT+PN,2^NUM:PRINT
150 PRINT"Now measure with a volt-
meter that bit (";NUM;") of port is
high"
160 INPUT " Hit enter when done,
<CTRL> <BREAK> to exit";ANS$
165 PRINT:GOTO 130
```

If all works as planned, your interface is complete. The only remaining thing is to strip and tin the free ends of the interface cable and solder the correct lines to the decoder board output pins. Remember to connect at least one earth line. I would strongly suggest that you provide some form of strain relief to the cable at the decoder using a cable tie.

Setting Levels on the Decoder

On a 2400 Hz input signal, you should initially adjust decoder VR2 (offset) voltage at IC5 pin 6 so that black turns to your first gray level on screen at about 0.3V DC. Peak white should be at around 5V. On a live satellite signal, set VR1 to two o'clock and adjust VR3 (coarse gain) so that you have comfortable travel for VR1. You can fine-tune these settings when receiving your first satellite signals using JVFAX 6.0, as JVFAX 6.0 has a very useful facility that will display your instantaneous picture brightness as a number from 0 to 255 in a window on screen.

Sometimes you will get a picture on screen that looks chaotic—the gray levels do not seem to be the right values. In this case, check that you have wired bits 0-7 from the output of the decoder to the input of the 8255 in the right sequence. Be careful—the decoder board bit output pins do *not* go in a bit-0-to-bit-7 sequence. Match the output bits of the decoder (they are shown on the PCB) to the correct PA0-PA7 bits on the interface cable.

Figure 3 shows a Meteosat APT transmission, received using the decoder and display equipment described in this article. This is an example of the kind of quality achievable from Meteosat 4 APT. It was captured on PC using JVFAX 6.0 at 800x800x256 resolution, then transferred and played out via Apple Macintosh to a laser imagesetter with minimal processing. The GIF file was 650K in size. You cannot fail to recognize the Red Sea, but particularly interesting is the detail available showing the course of the Nile river, Lake Nasser, and the desert features inland. My 10-year-old son and I had a ball with an atlas identifying relief contours in the Saharan desert. What we proved was that what you see doesn't always exactly follow the picture in the atlas! This is what makes this hobby so rewarding! Note the JVFAX real-time status display on screen showing the instantaneous pixel values. In this illustration, they are centered around 30% gray.

Figure 4 shows the current station I operate. The receiver and PLL VFO are as offered in the ZS6BNT kit, available from me (see the address at the end of this article). The receiver is a sensitive dual-conversion design, with the second IF at 300 kHz, which is optimized for weather satellite reception. The low second IF frequency is chosen to optimize noise. The VFO output frequency is locked to the stable LFO.

The tone-operated squelch is used to open receiver audio on receipt of a 2400 Hz satel-

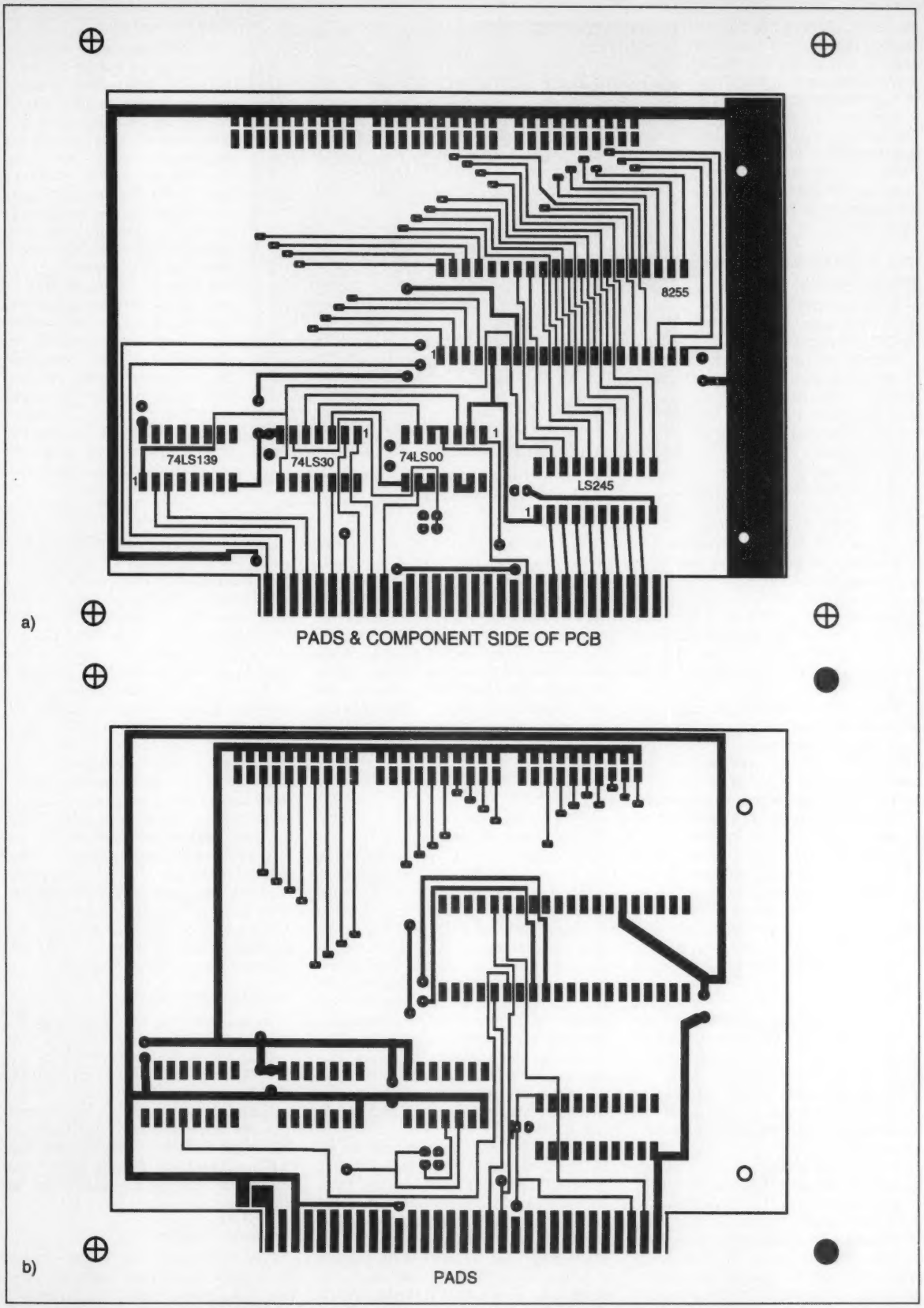

Figure 3a.) 1:1 PCB layout, component side; b) 1:1 PCB layout, solder side.

lite signal, which in turn triggers the start of a picture recording on the PC. This allows unattended recording on a casual basis. The S-meter is just an op amp in a bridge circuit for zero setting of the meter. The demodulator is the one described in the previous article. The preamp is a mast-mounted Hamtronics unit, and the antenna is the WB8DQT design.

The JVFAX 6.0 Shareware Fax Display Program

I first came across JVFAX 6.0 when browsing through the HAMNET libraries on CompuServe. It was described as a fax program. It is all that, and more. JVFAX 6.0 was written by Eberhard Backeshoff DK8JV, and all he asks is that those who download the program operate on the shareware honor system, where a donation is requested. Sending a donation will get you the latest version of the program on disk, as well as a variety of alternative hardware interface designs for interfacing your PC to your receiving system. I implemented the system using the home-built decoder unit described last month. DK8JV offers an innovative hardware and filter design for 255 gray scales using the control lines on a PC RS-232 port! The details are at the end of this article.

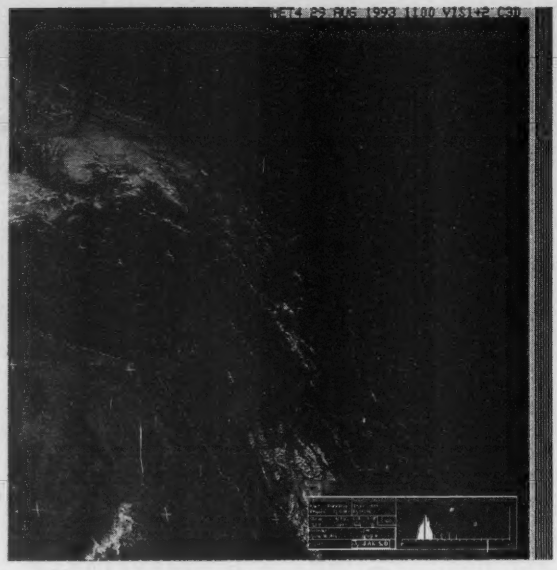

Figure 4. Meteosat APT transmission, received using the decoder and display equipment described in this article.

JVFAX 6.0 will decode and display just about any facsimile transmission, from FM-modulated weather chart transmissions on HF or SSTV to AM transmissions from weather satellites. It will do this at all accepted line rates and aspect ratios. A variety of interface schemes are catered for. Of course, weather chart transmissions use a tone that varies in frequency (FM) to encode white to black, so a different type of interface is required between the receiver and the PC. Weather satellites present a signal varying in amplitude, so are known as AM transmissions despite the confusing fact that they are carried on an FM transmission medium in the first place!

Pictures can be stored to hard disk in real time, with a computer of sufficient speed (286 or better). Yes, that is right: While the picture is being received, your computer stores the picture to hard disk! Early programs used memory storage only to store pixel values. Storing in real time to disk gets one around the constraint of limited memory in your PC.

A variety of display monitor types are catered for, including Hercules, CGA, EGA, and VGA. However, if you want good results, you should try to stick with VGA. Within the VGA environment many VGA modes are catered for, the most common of which is 640x480x16 gray scales. A variety of set-up screens allow direct setting of VGA video card registers to implement different modes, for those of you who like to experiment with such things. My most-used mode is SVGA 16-color (gray scales). JVFAX will actually dither the 16 gray scales so that 64 gray scales are actually represented on screen. Being lucky enough to have access to high resolution display equipment in my job, I have had fun implementing some of the VESA modes available, and have been able to display 1024x768x256 gray scales directly off Meteor, NOAA, and Meteosat transmissions, for spectacular displays.

Configuration

JVFAX 6.0 comes with a comprehensive English manual in the form of a disk file. When printed out, it gives you everything you need to know about the operation of this excellent package. We will not delve into the specifics of operational detail here, except to say that a number of things need to be set up before you can receive pictures. You need to set up your parallel interface address, the number of bits for the pixel, your monitor type, the printer, the default directory where pictures will be stored, and the satellite configuration which you will be receiving. This is all done on a configuration screen. Pictures are stored in CompuServe GIF format, which makes for easy interchange of data, as well as an efficient, compact picture storage format.

The video display modes catered for are CGA, Hercules, EGA-Hires, EGA 640x200, EGA 640x350, AT&T 640x400, VGA 640x480x16 colors, and SVGA 16 and 256 colors. A useful feature is being able to customize SVGA parameters by directly addressing the AH, AL, BH, and BL registers in your computer to set the video mode. For instance, I can set 640x480x16 SVGA mode 58 by setting the AL register to 58.

Mode Configuration

A database of satellite or fax type can be set up on a Mode configuration screen. This contains details of the lines per minute, the Index Of Co-operation (IOC is a rather academic way of stating the picture height-to-width ratio—I cannot believe the obtuse way academic types describe the simplest things!). Also required are the resolution in pixels per line, the number of intensity levels, and details of the satellite or fax transmission start and stop tones for automatic phasing, starting, and the stopping of any transmission. Each mode of transmission can be separately stored and called by name and changed on the fly when receiving pictures. Note that on some slower computer systems such as 8086 XT-based systems, the 120 LPM and 240 LPM line speeds only work when you choose lower screen resolutions.

Setting up Sync

One of the more important adjustments required is to set the line clock rate in JVFAX 6.0 to match exactly the spacecraft line clock rate. Otherwise, pictures will appear slanted on-screen, and if the timing is far enough off, the pictures will not be recognizable at all! As PC clock speeds vary widely, and the receive sync is controlled by the computer clock, you will have to make an initial set-and-forget adjustment to lock the spacecraft line rate to your computer. JVFAX 6.0 has a novel way of setting this. By pressing a key when viewing a picture, you get a vertical line which you can slant using the keyboard arrow keys so that it parallels the angle of slant of the sync line on the received picture. Hit "save," and that's all there is to it. You never have to set it again for the same spacecraft. It is stable too, because the sync is derived from the computer crystal-controlled clock. Other packages I have used required software timing loops to lock sync, which produced dreadful results because every time I reloaded the software, sync drifted.

Automatic and Manual Sync

On spacecraft that have start, sync, and stop tones, JVFAX can automatically place the sync line on the correct side of the picture. With the continuously transmitting NOAA satellites, sync pulses are very short and are difficult to decode, so you must manually move the picture sync bar to the left or right to display a whole picture. With GOES and Meteosat, phasing, picture start and stop are entirely automatic when the software is set up correctly.

Automatic Reception

JVFAX 6.0 can use time and date data in the PC clock to go into an unattended reception mode, and store the results to disk in a

Continued on page 18

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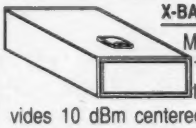

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Continued from page 16

series of picture files. If you have set up the start and stop tones of JVFAX correctly, the software will recognize this, and close off picture file storage at the appropriate time. This is fine for GOES, Meteosat, and many fax transmissions which have clearly-defined start and stop tones, but not very useful if you are trying to receive continuous transmissions from the polar orbiters. In this case, reception starts at the satellite AOS time (as defined in JVFAX 6.0), and closes at the LOS time. You should set the AOS time a minute or two after the satellite rises above the horizon; this way you get the best picture quality and the smallest file size because you avoid the signal fades that occur right after satellite AOS when the bird is just above the horizon.

Because you can set an individual reception mode at any time, you can automatically switch modes after every picture received. JVFAX 6.0 also has the ability to execute a separate program just before it switches to automatic receive. In my case, this would usually be a program written in BASIC. It sets up receiver frequency via the parallel interface, using port PA1 on the 8255. You could also use the 8255 to switch receiver audio lines as well.

Fax Transmissions

The software will transmit displayed pictures in WEFAX 288, WEFAX 576, Ham 288a, and Ham 288b format. The easiest option is to take the modulated output off the PC speaker, in which case some low-pass filtering and signal attenuation will be needed to clean up the waveform before feeding to the TX input of your rig at the correct level.

Movie Option

You must have seen the animated weather pictures on your local TV station, which show cloud patterns moving across a stationary map. CNN does this, and the British Sky News has spectacular 3-D cloud views in their weather slots. JVFAX 6.0 will store multiple pictures of one GOES or Meteosat quadrant, which are only separated in time. The ground features appear to be standing still, but the clouds move! You will need access to your local GOES or METEOSAT transmission schedule. You then set up automatic reception times for the same quadrant (picture) based on the schedule. Fifteen seconds before due time, JVFAX 6.0 will switch to reception mode and await a satellite picture start tone, then store the results in a sequentially-numbered disk file. When displayed, these files are sequentially loaded into RAM on the fly (so the more memory you have, the better).

Receiving Pictures and Adjusting Your Decoder

From the main screen, selecting the FAX option will put you into reception mode, and the software awaits the first picture line. This builds up line-by-line from the bottom of the screen. When the line reaches the top of the screen, the whole picture scrolls downwards. Hitting the RCS key while receiving will bring up a window that shows a histogram of the white-to-black instantaneous picture values. This allows you to adjust the histogram so that most of the black-to-white energy is displayed in the middle of the X-axis on the graph, thus optimizing your black-to-white ratio. An option allows for display of the instantaneous 0-255 value of picture intensity as well. This is useful for setting up your interface. Simply feed a constant 2400 Hz tone to your decoder, adjust VR1 to 2 o'clock, and adjust offset pot VR3 for a value of 255—when the peak white LED just begins to light. No signal should give a value of 0.5 on the display. You can also adjust peak levels while receiving pictures, if you have GOES or Meteosat receiving capability. On these satellites there are lots of transmissions with 10 seconds or more of continuous peak white or full black. This allows adequate time for you to get that adjustment screwdriver in there. With NOAA transmissions this is a little more difficult, as white and black pictures are transmitted side by side, and so your peak white and peak black values do not stay there long enough to allow definite measurement. In this case, experiment for best results.

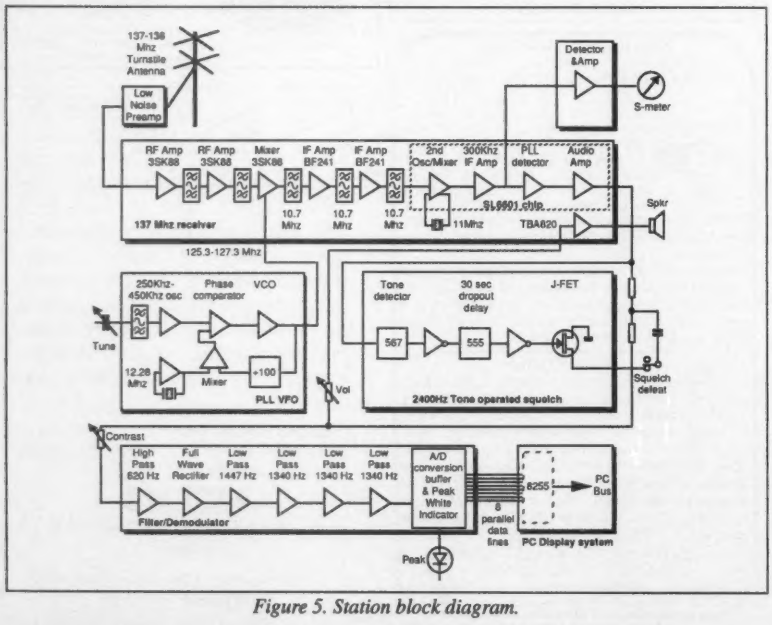

Figure 5. Station block diagram.

Zooming, Rotating, and Colorizing Pictures

In the view mode, you can recall and display any stored picture. All pictures received casually are stored in a temporary file called TMPPIC.GIF on disk, which can be renamed if required. Each succeeding picture overwrites the temporary file. In this way, you do not require limitless disk space and you can extract your best pictures by renaming them. A Q(U)ick save facility on screen will ask for a filename. In real time, you can only see part of the unfolding picture on screen but the whole picture is stored, and on a 15-minute NOAA pass this can occupy over 2.7 Mb of disk space! When in view mode, JVFAX 6.0 allows you to zoom into any part of a stored picture. You simply frame the area required to be enlarged by using keyboard keys and it zooms in to fill the whole screen. So, the smaller the frame, the bigger the magnification. Too much magnification will bring it to a point where the pixels become very "blocky"—they appear to be square. This is caused by the dithering technique used. You can zoom the picture 10 times, but a practical maximum is about four times; with greater magnification than this viewing results generally become unacceptable.

You can rotate or invert pictures. If you use the SVGA 255 color mode, you can colorize the picture with red, green, and blue in various intensities to create very natural-looking color displays, which seem to be optimized for a natural-looking picture—for instance, ocean colors could be blue, ground is brown or green, and clouds are white. A graphical sliding pointer allows for easy setting of color values.

Using a feature called JVcolour, a fairly natural false color image can be displayed while received, with seas deep blue, land blue or green, and clouds white.

How Do I Print My Pictures?

There are a number of printer formats set up for JVFAX 6.0, which work on printers connected to the PC's printer port(s). Most of these are dot matrix types, following various EPSON or IBM formats. I have never been able to get a decent-looking picture off a dot matrix printer, because they are incapable of printing gray scales directly and must emulate a gray scale by clever programming;

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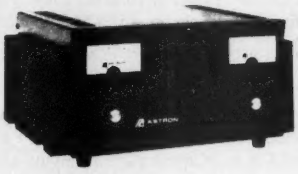

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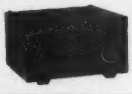

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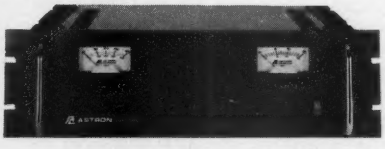

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RM-50A	37	50	5¼ × 19 × 12½	50
RM-60A	50	55	7 × 19 × 12½	60
• Separate Volt and Amp Meters				
RM-12M	9	12	5¼ × 19 × 8¼	16
RM-35M	25	35	5¼ × 19 × 12½	38
RM-50M	37	50	5¼ × 19 × 12½	50
RM-60M	50	55	7 × 19 × 12½	60

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RS-4A	•	•	3	4	3¾ × 6½ × 9	5
RS-5A		•	4	5	3½ × 6⅛ × 7¼	7
RS-7A	•	•	5	7	3¾ × 6½ × 9	9
RS-7B	•	•	5	7	4 × 7½ × 10¾	10
RS-10A	•	•	7.5	10	4 × 7½ × 10¾	11
RS-12A	•	•	9	12	4½ × 8 × 9	13
RS-12B		•	9	12	4 × 7½ × 10¾	13
RS-20A	•	•	16	20	5 × 9 × 10½	18
RS-35A	•	•	25	35	5 × 11 × 11	27
RS-50A	•		37	50	6 × 13¾ × 11	46
RS-70A	•		57	70	6 × 13¾ × 12⅛	48

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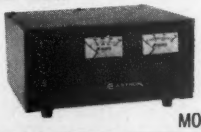

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• Separate volt and Amp meters				
RS-20M	16	20	5 × 9 × 10½	18
RS-35M	25	35	5 × 11 × 11	27
RS-50M	37	50	6 × 13¾ × 11	46
RS-70M	57	70	6 × 13¾ × 12⅛	48

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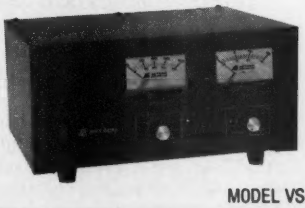

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VS-20M	16	9	4	20	5 × 9 × 10½	20
VS-35M	25	15	7	35	5 × 11 × 11	29
VS-50M	37	22	10	50	6 × 13¾ × 11	46
• Variable rack mount power supplies						
VRM-35M	25	15	7	35	5¼ × 19 × 12½	38
VRM-50M	37	22	10	50	5¼ × 19 × 12½	50

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MODEL RS-12S

• Built in speaker

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* Amps	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-7S	•	•	5	7	4 × 7½ × 10¾	10
RS-10S	•	•	7.5	10	4 × 7½ × 10¾	12
RS-12S	•	•	9	12	4½ × 8 × 9	13
RS-20S	•	•	16	20	5 × 9 × 10½	18
SL-11S	•	•	7	11	2¾ x 7⅝ x 9¾	12

*ICS—Intermittent Communication Service (50% Duty Cycle 5min. on 5 min. off)

CIRCLE 16 ON READER SERVICE CARD

they print the dots further apart or closer to create the gray scale. Although I haven't used it, the HP Laserjet 500+ driver looks promising as laser printers can create limited gray scales but have 300 DPI resolution. I have used the CITOH 8510 driver and it prints fine within the capabilities of a 9-pin dot matrix printer. JVFAX allows you to balance printing intensity for various levels of gray on these printers, a useful feature that allows better-looking printouts.

Confessions of a Cheat

I have to confess that I cheat. Being in the computer graphics business, I transfer my stored GIF picture files over a local area network onto an Apple Macintosh, where I enhance them if needed, and then print the pictures to a PostScript laser printer, or directly to a Laser Imagesetter. All the pictures in this article were produced this way. One of the by-products of this route is that it is easy to produce mosaics of the whole earth by automatically capturing the nine Meteosat pictures required with JVFAX 6.0 and then joining them together as a single picture using a program called Adobe PhotoShop (see picture on page 3.) Registration between spacecraft transmissions is so good that I defy anybody to spot where the pictures join! However, as there is anything up to a three-hour gap between the first and last transmissions of the nine pictures in the Meteosat transmission schedule, winds can move the clouds during that time, causing some misregistration in cloud patterns between pictures.

Using the System

A typical satellite pass at my station would be captured thus: I prepare a series of simple GW BASIC programs, whose file name is the satellite name. This executes by outputting a simple binary number to separate output lines on port PA1 of the 8255 chip. Each program (for each satellite) contains a different PA1 output value. For instance, program NOAA11.BAS will make only line 1 of PA1 go high, NOAA12.BAS will make line 2 only go high, and so on. Since you can call any BASIC program when calling any satellite configuration on JVFAX 6.0, switching is easy. The output line, with some suitable buffers, is used to enable an oscillator crystal in the receiver via diode switching. By executing the appropriate program, one can change receiver frequency.

Using the InstantTrack satellite tracking program, I scan the best satellite passes of the day, noting the satellite name, acquisition time (AOS) and loss of signal (LOS) time. This information is fed to JVFAX 6.0. At 15 seconds before the appropriate time, JVFAX will select the appropriate satellite, and execute the BASIC program for the satellite being received. This adjusts receiver frequency and selects the specified satellite type (line rate, etc.). It will then go to receive mode, awaiting opening of the receiver squelch. At AOS squelch opens, starting picture recording. At LOS time, or on closing of receiver squelch, the computer file will close, and the software awaits the next programmed satellite AOS time.

Just be aware that you need a large hard disk capacity if you want to automate lots of passes during one session!

Where Do I Find the Satellites?

You have a PC. The easiest way to predict a satellite pass is to obtain one of the excellent satellite tracking programs to run on your PC. I like InstantTrack (available from AMSAT NA) because one of its options is a fantastic real-time world map display of the satellite pass. To update InstantTrack, you can load the latest Keplerian (orbital) elements in NASA format automatically into InstantTrack from files downloaded off CompuServe or other BBS systems. Other tracking programs abound. Look in the CompuServe "Amateur Satellites" library; there are a number there. Failing this, you can just tune your receiver to the correct frequency and wait for a signal. Because the NOAA satellites are in "Sun Synchronous" orbits, they will pass within range of a ground station anywhere on the earth's surface from two to four times a day, and at about the same time every day.

RF Interference

All PCs are "RF dirty." They emanate harmonics on all sorts of frequencies. Generally, at VHF this is not as much of a problem as HF, but when I first implemented my system I had a nasty harmonic almost slap on 137.5 MHz, one of my most-used frequencies.

By careful shielding of antenna and cables and earthing the computer box directly to a ground spike, I was able to get rid of most of the interfering carrier. I found that shielding the cable between the demodulator and the interface gave the most reduction in interference. Although you can buy ribbon cable with shielding on one side, the easiest fix is to cut a number of lengths of aluminum kitchen foil and wrap it around the cable. Experiment with the best point at which to earth the cable.

Conclusions

I have tried to give all the information and hints necessary to allow you to build up an affordable weather satellite receiving station. My results have been very rewarding, and I would like to hear from anyone who implements this project. Write to me at the postal address given below, or on CompuServe 70272,1602. JVFAX 6.0, being shareware, gives very good value for the money, in addition to unbelievably good displayed pictures.

If you want to learn more about receiving weather satellite pictures, I heartily recommend WB8DQT's publication *The Weather Satellite Handbook*, Fourth Edition (or maybe fifth by now), available from Uncle Wayne's Bookshelf. Ralph Taggart is a genius at explaining the arcane subject of satellites and weather to laymen. Expect plain, simple-to-understand language, and a comprehensive coverage of the subject, together with easy-to-understand constructional information.

Please support DK8JV in his programming efforts by giving a donation. In return, he will send you the latest version of JVFAX, as well as a lot of interface details, including a sophisticated FM fax decoder schematic for HF use, all on disk files.

Complete kits for the parallel interface board are available from me for $40, which includes international air parcel post and packing. For international customers, be aware that sometimes there might be customs duties to pay in your country.

JVFAX 6.0 is available for $10, which covers the cost of the disk and international airmail postage (or you can download the earlier version from CompuServe Hamnet): Angus Anderson, P.O. Box 41544, Craighall 2024, South Africa; Tel: (business hours) country code 27, city code 11, 807-1163; Fax: (business hours) country code 27, city code 11, 807-1167; CompuServe: 70262,1702. I accept Visa, MasterCard, cash, or international money orders. No checks, please. South Africa is two hours behind GMT, six hours behind EDT, and nine hours behind PDT.

You can contact Eberhard Backeshoff DK8JV, the author of JVFAX, at Obschwarzbach 40a, D-4020 Mettmann, Germany; Tel: (49) 2058/4864 (please—only between 18:00 and 19:00 CET) ZR6UM suggests a $25 donation. It's well worth the trouble. You get more back than you donate!

Parts List, Parallel Interface

C1,C2,C3,C4,C5,C6	0.01 µF
IC1	74LS00
IC2	74LS245
IC3	74LS139
IC4	8255PIO
IC5	74LS30

Miscellaneous:
Capacitors are disk ceramic, 16V or more.
PC board, double-sided with edge connectors (if not plated through, see comments).
1 x 20-pin DIL IC socket
2 x 14-pin DIL IC socket
1 x 16-pin DIL socket
1 x 40-pin DIL socket

(Note: Use high-profile IC sockets with exposed top pins if not using plated-through PCB. This allows soldering to IC connections on both sides of the PC board.)
3 x 20-pin PCB mount box headers, male. I suggest that you buy a strip of 70x2 pin headers and cut to suit.
1 x 20-way ribbon cable, length to suit, with a 20-way crimped female box header on one end, free cable on the other. The free ends are soldered to decoder vero pins via an optional interface socket.
2 x 2-way jumper pins and jumpers. You can use offcuts of the 20-pin box headers if you buy the box header strips and cut the number of pins to suit. The jumpers can be obtained from almost any old PC PCB.

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Optional CW Audio Filter SXCWN WT.....$49.95 Kit $39.95

Miniature SPEAKER-MIKE

Fits Icom, Yaesu, Alinco, Ramsey and Radio Shack rigs! Looking for a handy little speaker-mike to compliment your FX transceiver or other ICOM style handie-talkie? The Ramsey SM-1 speaker-mike is a beauty. It's only 1 1/2" wide by 2 1/2 inches high and has a handy clip on the back so you can easily clip it to your lapel or shirt. Its small internal speaker isn't going to break any eardrums but is very clear and has plenty of pop to be heard when worn. There's even a jack on the mike so when you plug it in, you still have the use of the speaker jack from your radio. Fits all Radio Shack, ICOM, Yaesu, Alinco and Ramsey rigs.

SM-7 Mini-Speaker mike,
Fully assembled.....$24.95

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Shortwave receiver kit, SR1.....$29.95
Shortwave converter kit, SC1.....$27.95
Matching case set for SR1, CSR .. $14.95
Matching case set for SCI, CSC ...$14.95

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Add some fun to your club events by having a transmitter hunt! Foxhunting is a craze sweeping the nation, but many clubs are missing out on the action because they lack the expertise or time to develop their own foxhunt transmitter. We set one of our most devious and sneaky engineers to the task of designing an easy to build and use, yet highly capable Foxhunt transmitter. A snazzy microprocessor controller has both preset and programmable transmission characteristics allowing you to easily set the difficulty level from "beginner" to "know-it-all"! The SlyFox, FHT-1, is crystal controlled in the 2 meter band (crystal for 148.52 included) with a power output of 5 watts that is adjustable by the controller.The transmitter is programmed to ID in CW or add our voice option if you really want to aggravate the troops - "Ha ha, you can't find me!" Join the fun, get rid of those stuffy old meetings and picnics, have a foxhunt!

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CIRCLE 34 ON READER SEVICE CARD

Build an Intelligent Relay

A quick-to-make microprocessor-based device, controlled by your HT.

by Bruce R. Knox N8LXS

If you want to check out a length of coax, remotely reset a cluster or BBS node, or test a doorbell installation, you often get someone's help. Wouldn't it be nice to have a device that could provide you with a contact closure, at your command, using your hand-held transceiver (HT)? This article will show you how to build such a device, which provides you with a set of functions that will make your life a whole lot easier in these situations.

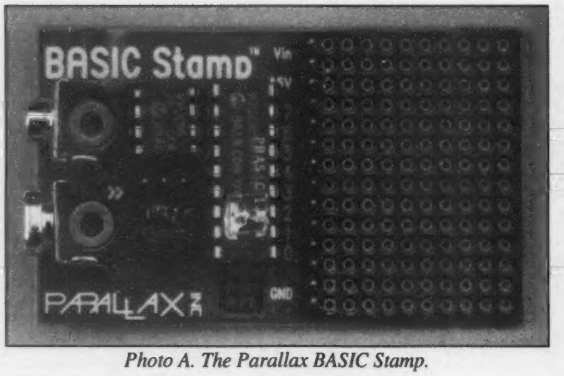

Photo A. The Parallax BASIC Stamp.

You Need a Microprocessor

In order to provide a set of useful functions, some form of intelligence would be required for this device. I looked over the range of microprocessors available and most seemed to be gross overkill for such a simple application. In most cases, even simple single-chip microprocessors like the Motorola 68HC705xx require a multi-hundred-dollar development environment and a lot of construction to gain even basic functionality.

Enter a nifty product from Parallax, Inc., called The BASIC Stamp. This is a simple-to-use but highly functional microprocessor that fits this (and many other) applications perfectly.

What is The BASIC Stamp?

The BASIC Stamp is a PIC microprocessor mounted on a small printed circuit board (2.5" x 1.5", or 6.3cm x 3.8cm). It sports a 5-volt regulator, reset circuit, resonator, input/output (i/o) header for the eight i/o lines, and a 10 x 14 wirewrap/prototyping area. The folks at Parallax have developed code for the PIC microprocessor that interprets "tokens" generated by a BASIC language tokenizer that runs on a standard PC. This enables you to develop applications in a high-level language, download to The Stamp, and run. It runs your instructions at about 2,000 per second (50 microseconds per instruction, typically), and the supplied EEPROM (Electrically Erasable Programmable Read Only Memory) can hold about 80-100 BASIC instructions per program.

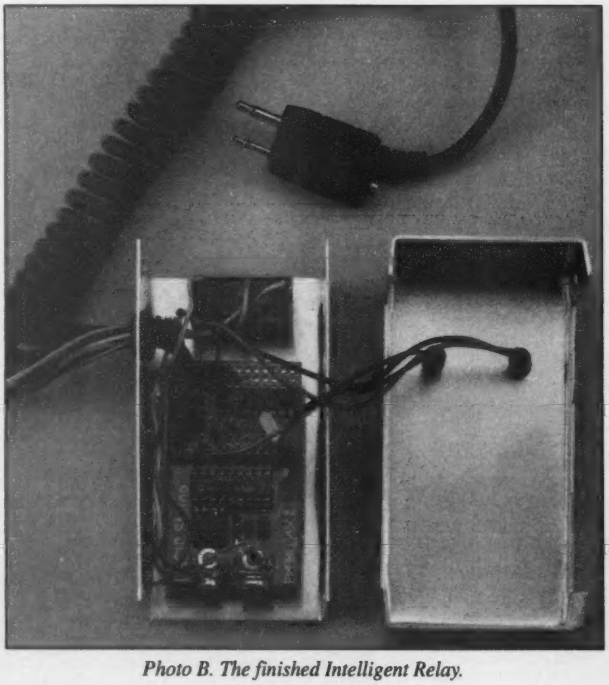

Photo B. The finished Intelligent Relay.

Figure 1 shows a brief summary of some of the more interesting Stamp BASIC commands. While the program speed/size limitations of this device will most likely prevent you from doing many digital signal processing applications on it, there are many others you will be able to do, and in a fraction of the time it might take you with a more conventional microprocessor environment. The best part is that the development environment that runs on your PC costs only $99 from Parallax, Inc., and you can use it over and over again. Stamps cost $39 in unit quantities, and discounts start at five units.

The "Intelligent Relay"

With this handy building block in hand, it was pretty easy to develop the application. Figure 2 shows the schematic for this application. It was built entirely on the prototype area of The Stamp using point-to-point construction techniques. The

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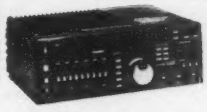

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MOTOROLA MARINE KING KX 99

YAESU	ICOM
FT-23R/26/76	IC2/3/4SAT
FT411E-811-911	IC02AT/2SRA
FTH-2008/7008	IC2/4GAT/24AT
	IC-A21/U16

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MAXON, MOTOROLA,
YAESU: FTH 2008/7008
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MARINE ICOM: M7, M56, M700
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CIRCLE 41 ON READER SERVICE CARD

basic hardware requirements for this device are:

1. Function from 12 VDC (The Stamp comes this way); 2. Provide a normally open and closed relay output; 3. Provide a DTMF tone decoder to receive commands; 4. Provide a means of transmitting tones from the HT If you are using a remote switch to check out an installation—it is really nice to know if, in the case of an unexpected result, your remote switch is working. To accomplish this, I made a connection to the microphone input of the HT. Through this connection, each command can be acknowledged by transmitting a Morse code "R." In addition, an "O" (a shortened version of "0") can be sent for off, an "A" (a shortened version of a "1") for on, and a callsign for identification purposes. The interface to the HT was implemented using capacitor C2 for the audio tone, and resistor R1 for keying the HT. You may find that you have to adjust the value of R1 or C2 depending on the HT you use. If the HT you choose does not support this hardware arrangement (keying and audio on the same wire), you can easily adapt it to support a relay for the keying and keep the tone generation output separate. Tone generation is handled by a command called "SOUND" in The Stamp's BASIC interpreter, and keying of the HT is handled by a simple logic level command (see the software listing).

Receiving DTMF (Dual-Tone Multi-Frequency) tones is pretty easy these days. A Teltone M-8870 DTMF receiver was chosen for this purpose. The M-8870 (U2) uses a minimum of external parts and runs off a single 5-volt DC supply. The outputs of the M-8870 consist of four data bits that tell you which tone was most recently decoded, and a strobe line that goes to 5 volts when a tone is present. These five lines are run to five of the eight lines on The Stamp. The M-8870 requires a cheap 3.58 MHz crystal (sometimes called a colorburst crystal), three resistors and two capacitors to get it running. In this application, none of the values (except the crystal value) are critical, with a 20% variance being acceptable.

The output from the device is a relay, designated as K1. This is a 12 volt DC relay that is powered from the external supply (before the on-board 5-volt regulator). Resistor R2 limits the base current to transistor Q1, and standard NPN, such as a 2N2222 or 2N3904. When saturated, Q1 energizes K1. Diode D2 is provided to snub the turn-off spikes generated by K1.

Diode D1 was provided for two reasons. The first and most important reason is to protect the device from a potential reverse polarity connection. The other reason is to introduce a volt or two of drop to limit power dissipation in The Stamp's regulator. Capacitor C1, a 0.01 disc, is provided to help keep RF out of the device.

As mentioned above, point-to-point construction techniques were used for this device. Photo B shows the finished unit is a small aluminum enclosure. Small, solid, insulated wire can be used, and the circuit can be built in about two hours. One word of caution: The column of holes in the prototyping area right next to the header are connected to the header! Use these holes to pick up your signal connections to the other parts of your circuit. Finally, a spare coiled cable was available for the device-to-HT connection. If you don't have one of these available, shielded cable and separate connectors will work just fine. The block diagram in Figure 3 shows you how the system is used.

```
Program Control

IF... THEN
GOTO
GOSUB
FOR... NEXT

Numbers

Integer math: +, -, *, /, etc.
Logicals: AND, OR, XOR, etc.

Digital I/O

LOW         set pin low
HIGH        set pin high
TOGGLE      change state of pin
PULSIN      measure pulse width
BUTTON      do button functions

Serial I/O

SERIN       Async serial input
SEROUT      Async serial output

Analog I/O

PWM         Generate PWM output
POT         Measure value of a potentiometer

Sound

SOUND       Generate tones/white noise on a pin

There are more commands.
```

Figure 1. Some of The Stamp's commands. (See Figure 4 for others.)

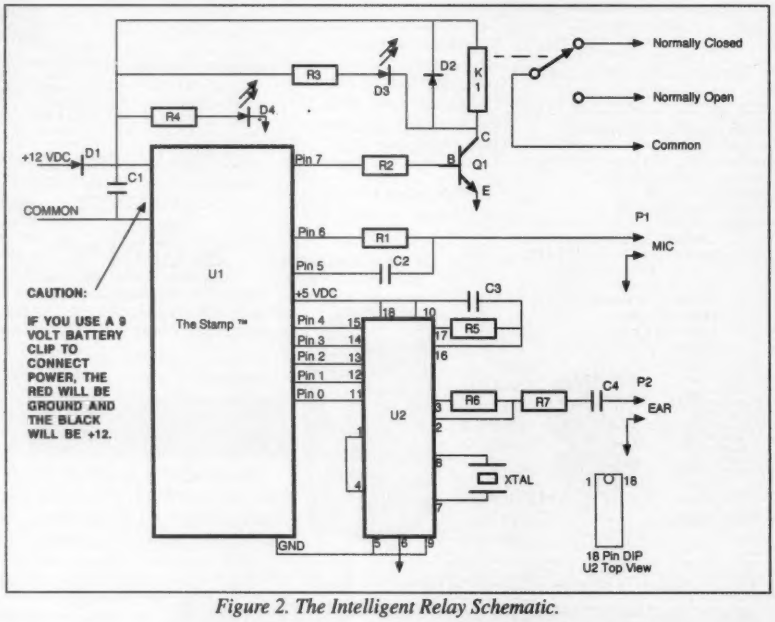

Figure 2. The Intelligent Relay Schematic.

The Software

Figure 4 shows the complete listing of the Intelligent Relay Program. The only reason

J-Pole in your Pocket?

Tough dual-band antenna for the travelin' man or the condo dweller. Hang-anywhere style and extra range can save life in an emergency.

James H. Gray W1XU

During my years of traveling around the eastern United States on business or vacation, I often wished I had a small, inexpensive and easy-to-use antenna to match my little handheld 2 meter radio. Occasionally I had an HF rig in the car, but more often it was the little 2 meter radio which was useful and fun. On long road trips it alleviated boredom, kept me awake and almost always assisted me to find a motel, restaurant, or other ham's QTH. On such trips the mobile antenna was fine until I needed more range from the motel.

When I traveled by plane, the rig was the handheld with no amplifier. It had only a small telescoping whip that I could extend to about 19 inches. If I happened to be close enough to a repeater in a large city, that was fine and I managed to "work" the locals in spite of low power and a minimal antenna.

But there were occasions when there was no local repeater, or when I was inside a steel-and-concrete building. At such times I wasn't able to make any contacts at all and had to resort to dull tedious television programs before going to bed.

If you face similar problems when traveling light and by air, you know how it feels to be alone among the many.

The Pico Solution

Today, the travelin' man has a ready solution to the problem: a neat antenna produced by Antennas West and called the "Pico-J." It meets all the requirements set forth in the first sentence. Pico means "small," as in "picofarad," and "J" stands for "J-pole," the well-known low-angle, omnidirectional vertically polarized antenna—just what's needed for 2 meters.

Antennas West's Pico-J offers some features not found in the usual J-pole. For example, the feedpoint is already found and matched for you, and the antenna is small and light—so much so that it can be rolled up and slipped into a small eyeglasses case. It looks like a sleek black ribbon 55 inches long. A six-foot small-diameter coax feedline comes off the bottom. Its gold-pin BNC attaches directly to your radio.

A small loop at the top may be slipped over a curtain rod or a nail or any other suitable projection. But, if by chance you don't happen to find a suitable support, Antennas West thoughtfully provides a small suction cup with an embedded hook that can be slapped up on a window or any smooth surface, and presto!—you're on the air!

Pico-J is completely weather-sealed and could be hung outdoors if you wish. Otherwise, you can hang it in a closet or a doorway; in fact, anywhere that is convenient and where your signal won't be blocked. The extra reach provided by this beauty could save life in an emergency, and is always useful when just plain chatting with the locals.

Your Pico-J stretches range, improves reception, reaches far-away repeaters, and saves your battery pack.

The measured VWSR is less than 2:1 between 142 and 150 MHz—ideal for CAP, MARS, and other services near the 2 meter band—and is a very beautiful 1:1 at 146 MHz. Not bad, eh?

Best of all, considering the benefits, is the price: $19.95 for the 2 meter model, $26 for the 2m/70cm dual bander, both complete with the soft vinyl case to store your Pico-J when it's not in use.

On a recent trip I tucked Pico-J into my briefcase, right next to the handheld. No, I didn't even use the "duckie" or the telescoping whip because I had all I needed in this one neat antenna. Maybe you'll find the same.

*–condensed from **RadioFun***

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Clip this ad and circle the TigerTail™. Send it with your order to get $5 off any purchase.

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*Who will see **Pico-J** hanging in your closet or on the balcony? But your signal will be heard. **Pico-J**'s half wave radiator is sleek and unobtrusive. his thin flexible feedline is barely noticeable. When his work is done Pico-J rolls up and slides into his pouch like the Genie slipping back into the bottle.*

*Carry **Pico-J** on hikes or trips as you would carry a pair of glasses. Keep him in your emergency jumpkit. When you need gain and low angle omnidirectional coverage pull out **Pico-J** and be full quieting when it counts.*

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Pilot's Pico-J $39—*Aviation band range booster for pilots on the go.*

Can You Find theTiger'sTail?

If your eyes are sharp you can spot the **TigerTail**™ in the photo above. It's not attached to something that bites; instead it puts extra growl into the signal from the HT it's attached to.

TigerTail™ improves SWR, lowers radiation angle, and extends range. You can use low power and save your battery pack, but still have a big signal.

Better than an amplifier, it improves reception too. **TigerTail**™ does all this by simply slipping under your flex antenna and just hanging down— without sticking up or out or getting in the way.

☐ **Yes, I want to increase range and save my batteries!**
___Send my Pico-J. 2m or 220=$19.95, Packet=$22, Dual=$26, Pilot=$39.
___Send my TigerTail. (1 for $7.95, 2 for $15, 3 for $21. Specify band)
___Send a combo (PJ + TT). (Just add $5 to your Pico-J order)*All prices ppd.*
☐ **Yes, I circled the TigerTail! Knock $5 off my order.**
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Antennas West
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CIRCLE 57 ON READER SERVICE CARD

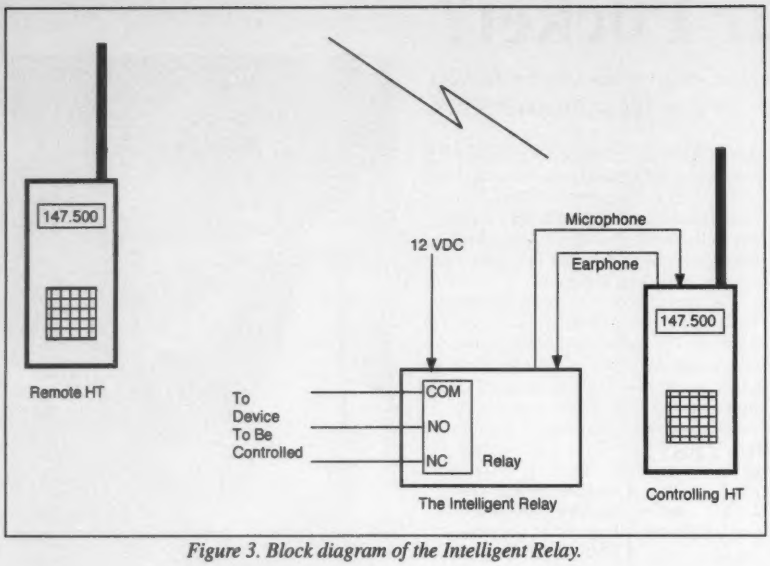


Figure 3. Block diagram of the Intelligent Relay.

the program looks so long is that it is heavily commented. The application performs the following functions:

DTMF 1: Turn relay on for 2 seconds, send "R"
DTMF 2: Pulse relay for x times (digit after 2), send "R"
DTMF 3: Turn relay on, send "R"
DTMF 4: Turn relay off, send "R"
DTMF 5: Toggle relay, send its new state
DTMF *: Send current relay state
DTMF #: Send ID (N8LXS in this case)

The most important feature of the software aspect of this project is the ease with which it can be implemented. You simply connect a three-wire cable from an LPT: Port on your computer to a header on The Stamp, run The Stamp program, enter your program into a text editor (included), type ALT-R when you want to run, and your program will be off and running. Bugs? Well, there's a DEBUG instruction that enables you to print variable values back to the PC to see what might be wrong. With the possible exception of making a pin into an output when it is connected to an external output, it's just about impossible to break The Stamp with software. So go have some fun!

Using the Intelligent Relay

You'll find many ways to use this device in addition to those mentioned earlier. Radio Shack HTX-202s were used to develop the design in this article. A Yaesu FT-470 was used as the remote radio, and this worked fine. However, when the FT-470 was connected as the Intelligent Relay radio, some problems with the radio keying were encountered. You can fix problems like this by playing with the values of R1 and C2. Also noted, a Kenwood TM-732 has a feature that phone patch users enjoy (I presume), but causes a problem here. The TM-732 does not release the PTT for about two seconds after the last DTMF digit is entered. This allows phone patch users to release their PTT while entering strings of digits. Even though the Intelligent Relay carries out its commands, the TM-732 interferes with the acknowledgement transmissions. You could fix this by changing the key-up delay in the program (or by not using the TM-732).

What Else Could You Do With This Design?

There are lots of things that could be done with this application. For example, you could monitor inputs and report them on command. Or you could transmit a call-sign with the relay (could be handy for remote on-air testing). But it is possible to run out of program space. So, depending on your application, you'll either have to get real clever in optimizing your code or you'll have to limit your functionality. The former is my preferred method, even though that method can drive you nuts!

Conclusion

In addition to DTMF-controlled devices, The Stamp lends itself to many other applications. You could make a custom keyer, a rotor controller, an antenna switch, or many other simple controllers. And since the device is software-driven, you can now dazzle your friends with fancy features that couldn't be done before without a large bag of TTL or CMOS chips and a lot of time and aggravation. Have a good time working with this powerful, yet simple, device.

Parts List

R1	2.2k 1/4W	
R2,R3,R4	1.0k 1/4W	
R5	300k 1/4W	
R6,R7	100k 1/4W	
C1	0.01 25W VDC disc	
C2,C3,C4	0.1 25W VDC	
D1,D2	1N4001	
D3	Yellow LED	
D4	Green LED	
K1	Relay	Radio Shack #275-249-A
P1	Mike connector	Radio Shack #274-290
P2	1/8" connector	
Q1	2N2222 NPN transistor	
XTAL	3.579545 MHz crystal	
U1	The BASIC Stamp (Parallax)	
U2	Teltone M-8870 DTMF decoder	
Box	4" x 2-1/8" x 1-5/8"	Radio Shack #270-239
Hardware	4-40 screws/spacers/nuts for mounting The Stamp	
Grommet	3/8" grommet for cable entry	
Wire	Shielded cable/relay/power leads as required	

Parts Availability

A set of components, including The Stamp and a 3.5" disk with the source code on it, is available from RF Applications, Inc. for $95. We can program your Stamp for an additional $20 (please give us your call). Please order this kit by mail or fax, VISA/MC accepted (encouraged), at 9310 Little Mountain Road, Kirtland Hills OH 44060-7951; Fax (216) 974-9506.

Note: Unless you order The Stamp programmed from us, The Stamp RF Applications, Inc. supplies is unprogrammed. You'll need the Development Environment described in this article to load the software. The BASIC Stamp Development Environment is available from Parallax, Inc. 3805 Atherton Road, #102 Rocklin, CA 95765. Their telephone number is (916) 624-8333. The Stamp is a trademark of Parallax, Inc.

```
Rem BASIC STAMP Control Program
Rem Intelligent Relay
Rem By Bruce R. Knox
Rem RF Applications, Inc.
Rem August 28, 1994

Rem You may copy this code, but please acknowledge its origin.

Rem There is a DTMF decoder on 0-3, strobe (active high) is on 4.
Rem Pin 5 is used for transmit tone
Rem Pin 6 is the PTT for the radio
Rem Pin 7 is the relay output (active high)

Rem Commands:
Rem  1  = Pulse on for 1 second
Rem  2X = Toggle X times
Rem  3  = Turn on the relay
Rem  4  = Turn off the relay
Rem  5  = Toggle the relay then Function 11
Rem  11 = Report relay status (A=on, O=off)
Rem  12 = ID (N8LXS in this case)

Rem Set up Pin Direction Registers (5 ins and 3 outs)

Rem Pin 7 = Output: Relay,    1=ON
Rem Pin 6 = Output: Key Radio,     0=Keyed
Rem Pin 5 = Output: CW Tone Out
Rem Pin 4 = Input:  DTMF Tone Present, 1=Tone Present
Rem Pin 3 = Input:  DTMF Bit 3
Rem Pin 2 = Input:  DTMF Bit 2
Rem Pin 1 = Input:  DTMF Bit 1
Rem Pin 0 = Input:  DTMF Bit 0

dirs = %11100000

Rem relay off (there's an NPN transistor there, 1=on)

low 7

Rem A low on Pin 6 keys up the radio, so start unkeyed

high 6

Rem Wait for HIGH (1) on DTMF Data Present Line

loop0:
     if pin4 = 0 then loop0

Rem Mask off unwanted top four bits

     b2 = pins & 15


Rem Sort out command

     if b2 = 1 then func1

     if b2 = 2 then func2

     if b2 = 3 then func3

     if b2 = 4 then func4

     if b2 = 11 then func11

     if b2 = 5 then func5

     if b2 = 12 then func12

     loop1:
     if pin4 = 1 then loop1

     goto loop0

Rem Pulse relay on then off

func1:

     high 7
     pause 2000
     low 7
     goto wait_gone

Rem Pulse relay x times (x follows the 2)

func2:

     func2_loop:
          if pin4 = 1 then func2_loop

     func2_loop1:
          if pin4 = 0 then func2_loop1

     b3 = pins & 15
     b3 = b3 * 2

     for b4 = 1 to b3
     toggle 7
     pause 100
     next b4

     low 7

     goto wait_gone

Rem Turn on relay

func3:
     high 7
     goto wait_gone

Rem Turn off relay

func4:
     low 7
     goto wait_gone

Rem Toggle relay

func5:
     toggle 7

Rem Fall right into func11 to tell the state of the relay


Rem Use "O" for off, "A" for on (shortand Morse 1)

func11:
     if pin4 = 1 then func11

     if pin7 = 1 then func110
     pause 200
     low 6
     pause 400
     gosub dash
     gosub dash
     gosub dash
     pause 200
     high 6
     goto loop0

func110:
     gosub key_down
     gosub dit
     gosub dash
     pause 200
     high 6
     goto loop0

Rem Send call (N8LXS in this case)
Rem 1=dash, 2=dit, 3=intercharacter space

func12:
     gosub key_down
     for b2 = 0 to 21
     lookup b2,(1,2,3,1,1,1,2,2,3,2,1,2,2,3,1,2,2,1,3,2,2,2),b3
     gosub send
     next b2
     pause 200
     high 6
     goto loop0

Rem wait for DTF tone to go away before proceeding

wait_gone:

     if pin4 = 1 then wait_gone

     gosub key_down

     gosub dit
     gosub dash
     gosub dit
     pause 200

     high 6

     goto loop0

Rem Morse code/radio support routines

dit:
     sound 5,(100,5)
     pause 15
     return

dash:
     sound 5,(100,15)
     pause 15
     return

send:
     if b3 = 1 then dash

     if b3 = 2 then dit

     if b3 = 3 then send_delay

     return

send_delay:

     pause 80
     return

key_down:
     pause 200
     low 6
     pause 400
     return
```

Figure 4. The software. Nothing to it!

73 Review

Number 6 on your Feedback card

by Breckinridge S. Smith K4CHE

Yaesu USA
17210 Edwards Road
Cerritos CA 90703
Telephone: (310) 404-2700
Price Class: $400

The Yaesu FT-2500M

A rugged mil-spec radio.

Ah yes, there's nothing like unpacking a new piece of equipment—makes you wonder how they cram it all in the box. If you want an interesting exercise sometime, try repacking the radio and the accessories back in the box in the exact same manner that it was originally packed. You can't do it; it takes special training.

The FT-2500M's size in inches, which is not given in any of the ads, is 7.75 by 6.3 by 2.0. The measurements include the length of the knobs which, incidently, are covered with that magic rubber that gives what I call a "tactile feel."

Appearance and Construction

The radio looks neat and rugged, and projects a functional appearance. Square, no fancy curves. All the gee-whiz buttons that you occasionally use are hidden away under the secret access door located on the right side of the front panel under the tuning knob. The top and bottom covers on the chassis are made of tight-fitting, rugged ABS plastic. I would have preferred metal covers for better shielding, but later testing in a strong RF field resulted in no problems.

The power leads for the radio have a fuse holder in both sides of the line, which is a definite plus. The fuse holders are rugged and totally "grab" the fuse, not just touch the ends of it. The SO-239 antenna connector is mounted in a recessed area of the heat-sink portion of the large one-piece diecast chassis. The connector has real threads that match your connectors. I tried several makes of PL-259 connectors and they all screwed onto the radio without any problems. The recessed area of the heat sink provides some protection for the SO-239 antenna connector.

Bench Testing

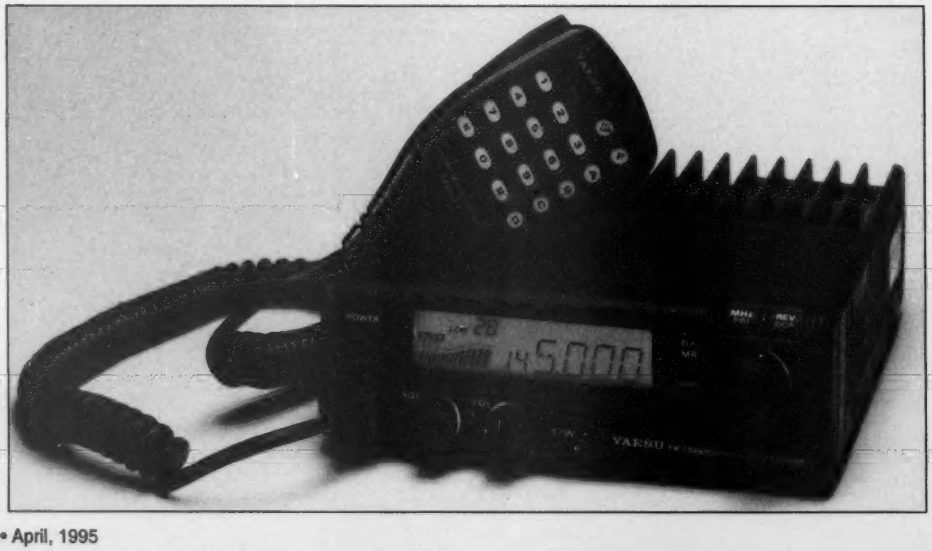
I fired the radio up and quickly checked the power and receiver specs. At 13.8 volts I measured 52 watts and found the power to be the same at both ends of the band. The power levels are selectable and can be programmed for each channel. The operators' manual gives instructions on how to open up the unit and set pots for the different selectable power levels. Mounting a quarter-wave ground plane antenna a foot away and standing behind a shield, I made several short transmissions with 50 watts. The unit operated in this unusually strong RF field with no problems. The automatic transmit power control was tested into several resistive loads representing SWR values starting with 3 to 1. Each test resulted in progressive lowering of the power. The final test consisted of just putting an emergency 19-inch wire in the rear connector and testing on the local repeater. Plenty of RF was available and the radio did not shut down. I don't recommend using just a 19-inch wire as a normal operation due to the radiation hazard and the poor load for the radio, but in an emergency it will work on the FT-2500M.

The transmitter has a "time-out timer" which can be programmed for five to 60 minutes. First thing I did was put in a five-minute limit. The timer resets each time you press the push-to-talk button and gives a little "beep" when the timer expires to remind you that you may be sitting on the mike button. I tested the timer on five minutes with 50 watts and, as expected, the heat sink got pretty warm but the power remained steady. There is also an automatic power-off timer, "APO," which will put the radio to sleep if you forget to turn it off. Since Yaesu recommends "direct" connection to your battery, this is a nice feature.

The radio looked clean on the service monitor and demonstrated a nice IDC (instantaneous deviation control) circuit which prevented me from over-deviating no matter how hard I yelled into the mike. Third harmonics in the 440 MHz band were well below 60 dB suppression.

Bench-checking the receiver sensitivity was better than the specs of 0.2 µV for 12 dB SINAD. Now for the first acid test of the system. I programmed the receiver to scan from 144 to 148 at 5 kHz increments to see if there were any internal "birdies;" *none* were found with or without an antenna. The image rejection specifications call for better than 70 dB. During the mobile testing I drove through two of our local "RF alleys" to check for desense and overload. The receiver reacted very well and responded with just a little noise from a local high-power paging unit with the squelch wide open. However, it was not enough to break a normal squelch setting. Checks for desense with an adjacent mobile working on the same repeater were excellent. One of our club members tried running 25 watts in close proximity but still did not cause any desense problems.

Yaesu appears to have built a pretty bullet-proof receiver using their "Advanced Track Tuning (ATT)." Quoting from the receiver sec-



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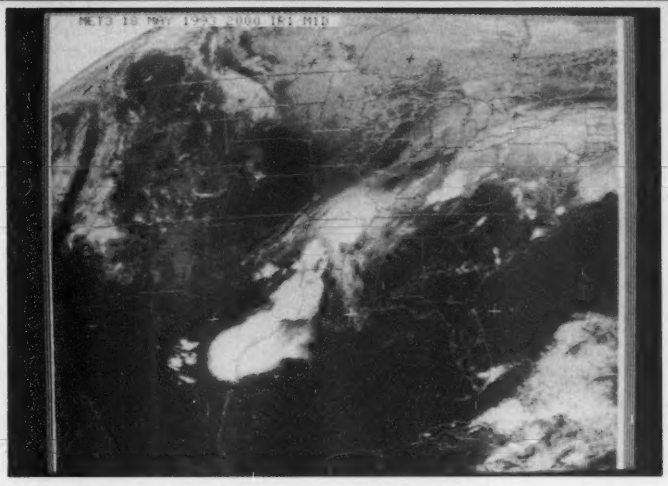

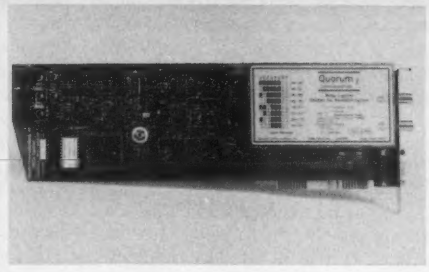

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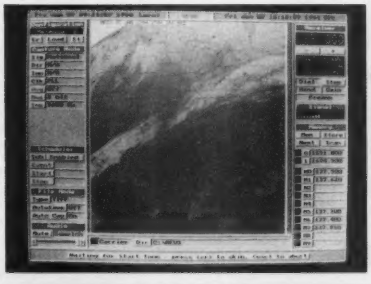

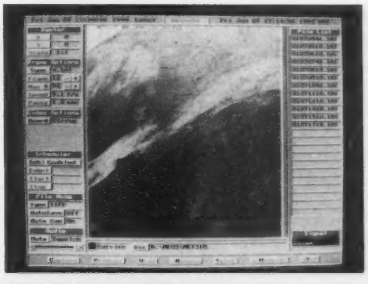

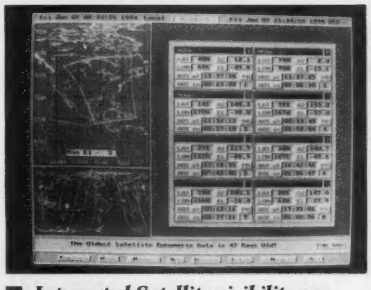

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tion of their technical supplement manual, "after passing the antenna switching network signals (received) within the frequency range of the transceiver are then passed through a varactor-tuned bandpass filter before RF amplification. The amplified RF is then bandpass-filtered again by varactor-tuned resonators to ensure pure in-band input to the 1st mixer."

Military Specifications

One of the reasons I purchased the radio was the "mil-spec" advertisement. I contacted Mr. Chip Margelli K7JA, the Customer Service Manager at Yaesu, and he sent me a copy of the testing procedure using MIL-STD-810C, the vibration test accomplished by United States Testing Company Inc. in February, 1994. A portion of the testing included mounting the radio to a test fixture. Then the fixture was "bolted to the shaker." The transceiver was then vibrated for three hours along several different axes at different frequency ranges varying from 5 Hz to 500 Hz.

After this was over they conducted the shock test series! Quoting from the United States Testing Company report, "The transceiver was activated and subjected to three shocks in each of the plus and minus directions of each axis, for a total of six shocks on each axis. The pulses consisted of a sawtooth waveform with a peak amplitude of 40 "G"s over a duration of 11 milliseconds." The United States Testing Company reported that the transceiver was "fully operational at the conclusion of the vibrations test" and "there were no physical anomalies noted."

Bells and Whistles and Other Features

The microphone uses a now-industry-standard telephone eight-wire modular plug. These rugged connectors can be purchased at any telephone supply store and are easy to crimp on. You can now put on a mike connector in 30 seconds instead of spending 30 minutes trying to solder those elusive little tiny wires. The microphone looks complicated and busy, but feels light to the touch. The mike has a "lock" switch on the rear which, when activated, locks up all the buttons except for the touch-tones. I spent quite a bit of time on the bench trying to get the radio to scan and then finally found the lock switch. But get this: *The mike glows in the dark!* Actually, just the buttons glow, but this lighting feature will help make those midnight autopatch calls a little easier. If you don't like your mike to glow in the dark there is a switch to turn the light off. Yaesu supplies the MH-27 mike with the radio but you can purchase the simpler MH-26 without the touch-tone pad.

There are 31 memory channels. Now, I know some of you will scoff and insist that you need at least 100 channels, but for me 31 was fine. All I wanted was a tough simple radio. You can program a "name" for each channel (for example, CLUB, MARS, etc.). The names may be up to four characters long. There are provisions for the usual channel scanning or programmed limit scanning, but there are no provisions for storage of telephone numbers. As is standard in a lot of commercial equipment, this radio can clone (program) another radio with its stored information via the optional cloning cable. Once nice feature is that in the event you decide to start over with the memory channels there are provisions for accomplishing a general memory reset to clear all information.

The radio is equipped with CTCSS encode but you have to purchase the decode module and install it. I purchased the CTCSS FTSK-17A and installed it myself. I followed the instructions supplied with the FTSK-17A but found that the mounting location for the module did not match my radio. Now what? If all else fails go to the operating manual, and indeed the correct picture and instructions were in the manual. I did not review the DTMF paging system as our local repeater will not pass DTMF codes, which is quite common in some repeater controller configurations. I have to mention the "Ringer Melody Settings" which can be utilized during DTMF paging. We have finally gotten to the peak of the "bells and whistles" phenomena. If you are into serious bells and whistles you may program a user-ringer melody using up to 16 digits which correspond to notes from the traditional music scale! If you are bored while driving down the highway you can play back the melody with a test sequence. Personally, I prefer the straight ringing sound which sounds just like a phone.

"The instructions received from Yaesu were clear and easy to follow and contained all the necessary cautions about out-of-band operations."

Not only is the microphone lit but you can also adjust the radio panel backlighting on the LCD display to a manual setting or let the photosensor adjust the brilliance of the LCD display. The large LCD display is very easy to read. Night is the best display, with a yellowish background which can be controlled by the photosensor. In very bright direct sunlight the LCD panel changes to a black-on-gray high-contrast display.

Modifications

It's time to get the soldering iron out.

Packet modifications: The unit is not, I repeat, not 9600-baud packet-ready. However, there are simple instructions with pictures in the operating manual. Basically it consists of mounting three chip resistors, two jumpers and a chip tantalum capacitor. These are chips and require quite a bit of soldering skill. The manual states that "if you are not confident then contact your Yaesu dealer for assistance." According to their customer service department, the 9600-baud kit is available for $1.

Since I am involved in DFing, or foxhunting, I immediately realized that the packet modification soldering pad connections gave me access to the receiver audio prior to the audio gates, de-emphasis, and high-pass filtering. Now I have a good clean audio connection point for my foxhunting equipment. Yaesu even provides a small cutout which allows for the exit of cables that is located in the rear of the unit. This cutout is normally sealed with a plastic plug.

The radio receiver section comes out of the box ready to cover 140 to 174 MHz. The transmitter unmodified covers 144 to 148 MHz. I wanted to modify the unit for USAF MARS but instead of using the instructions from one of those thick modification books that you can buy at hamfests I decided to write to Yaesu and ask for their official modification sheet. I included my MARS license, my amateur license, and a copy of my purchase invoice. The instructions received from Yaesu were clear and easy to follow and contained all the necessary cautions about out-of-band operations.

Operating Manual and Technical Supplements

I thought that the small operating manual was well-written. I reviewed the "in case of trouble" pages, which are designed to correct for "operator errors." The handbook contains the usual circuit diagrams and flow charts as well as diagrams for the optional modules. However, all it contains for the microphone is the pinout pattern for the connector. You will have to purchase the technical supplement if you want circuit diagrams of the mikes.

The small operators' handbook is in English and Spanish so you can brush up on either language. I kind of miss those earlier Japanese manuals that were written in a strange kind of technical English with wording that seemed to have several meanings requiring hours to decipher. These new manuals take all the adventure out of purchasing a new Japanese radio. The "Yaesu Technical Supplement" (service manual) is up-to-date and was immediately available. It contains all the diagrams of the mikes, and includes instructions for lithium backup battery replacement and panel lamp replacement, which require good desoldering skills.

Overall Evaluation

I liked the radio. It's easy to operate and has a very readable front panel display. The alternate function buttons are reasonable in their organization and the clever bells and whistles are still there, with most of them hidden underneath the secret door. The unit appears to be really rugged. The best overall attraction for me was the receiver front end and its ability to work in a multi-transmitter high-RF environment and to resist basic front end overload.

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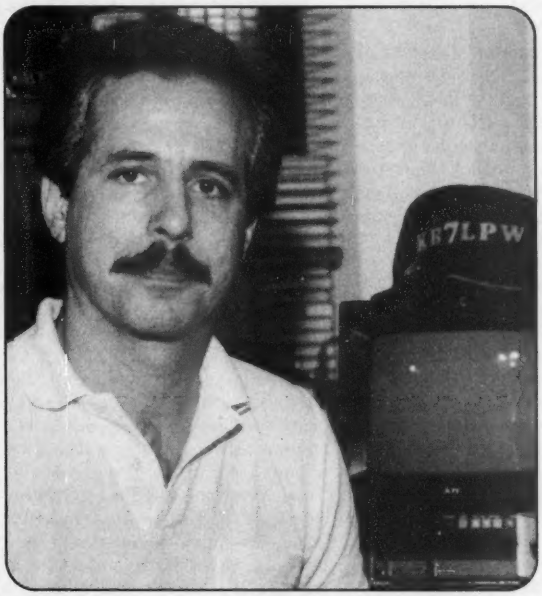

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73 Review

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The GAP Voyager DX

We compare the Voyager with a dipole in free-space.

Dipole antennas and verticals are the most popular choice for an easy way to get down on 40 meters, 80 meters, and 160 meters. On the "low bands" you will regularly hear amateur operators debating which antenna will perform better—the trap vertical for 40m-160m, or dipoles for these bands.

We decided to test our three independent, half-wavelength, unloaded dipoles, featuring the Centaur Electronics baluns, against a new GAP Voyager DX vertical which is designed for the 40m-160m band, plus additional resonance on the 20 meter band, too.

The Dipoles

Our dipoles for 40 meters, 80 meters, and 160 meters have been in place for about eight months, and each dipole uses the Centaur Electronics (Tucson, Arizona; 602/622-6672) "Big Bertha" coaxial choke balun, serial numbers 9457-9459. These monster baluns were suggested for our comparison by Centaur Electronics because of their Teflon insulation and all stainless steel hardware, plus their enormous size—perfect for a very rainy, wet Southern California environment.

Our comparison dipoles for 40 meters, 80 meters, and 160 meters were each cut to specific band resonance on the usual formula "length (feet) = 468/frequency (MHz)," where the overall antenna length equals the constant 468 divided by the desired operating frequency in MHz. We add about 1-1/2 feet of "fudge factor" at each end of our wire, and then cut the wire in two sections to be attached to the antenna balun and egg insulators, which will give us "fine-tuning" to the desired operating frequency.

Thanks to plenty of trees at the installation location of Bob Gregg AB6CH, we were able to obtain a minimum of one-quarter wavelength in height above ground on the 160 meter band to give us the best possible chance of a low angle of radiation. Each dipole was slightly drooped, and this is approximately the feed point height where our RG-213 non-contaminating coax was connected:

160 meters	130' elevated feed point (one-quarter wavelength)
80 meters	130' elevated feed point (half wavelength)
40 meters	130' elevated feed point (one wavelength)

We chose non-contaminating RG-213 because of its solid dielectric which would not soak up moisture during the California winter rainstorms. This proved to be a good choice for us after last winter's storms!

After the dipoles were hoisted aloft, it took about an hour or two of pruning and adjustment of each dipole with its individual feedline to bring our SWR down to a close 1:1.1. We used a relatively inexpensive MFJ SWR analyzer up on the roof, and then double-checked with a professional AEA SWR analyzer down below at the shack at the business end of the coax.

We were impressed with the Centaur Electronics balun because of its massive size for minimum internal I^2R losses, the three big "eyes" for hoisting the balun aloft and taking the strain off of the dipole wires, and the stainless steel wire lugs incorporating two 10-32 stainless steel binding posts with stainless steel wing-nuts for making electrical connections from the antenna elements to the balun. We could have used the bolts a bit longer, because both Bob and I managed to drop a nut on the relatively short binding posts.

The three dipoles with the Centaur baluns featuring true half-wave performance without any loading gave us consistently better signals from the West Coast than from other stations using lower dipoles and multiband dipoles to distant stations at the far end of the nighttime skywave range. Our results to stations well within the typical high-angle skywave range at night were almost comparable—low dipoles and loaded dipoles do about as well as big dipoles elevated way up when working a couple of hundred miles "easy path." But for reaching out to the furthest capabilities of a typical nighttime signal on 40,

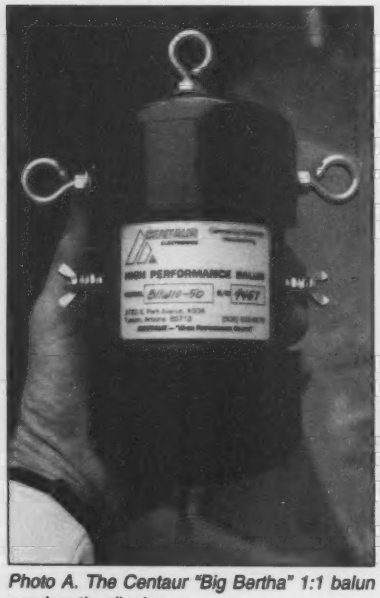

Photo A. The Centaur "Big Bertha" 1:1 balun used on the dipoles.

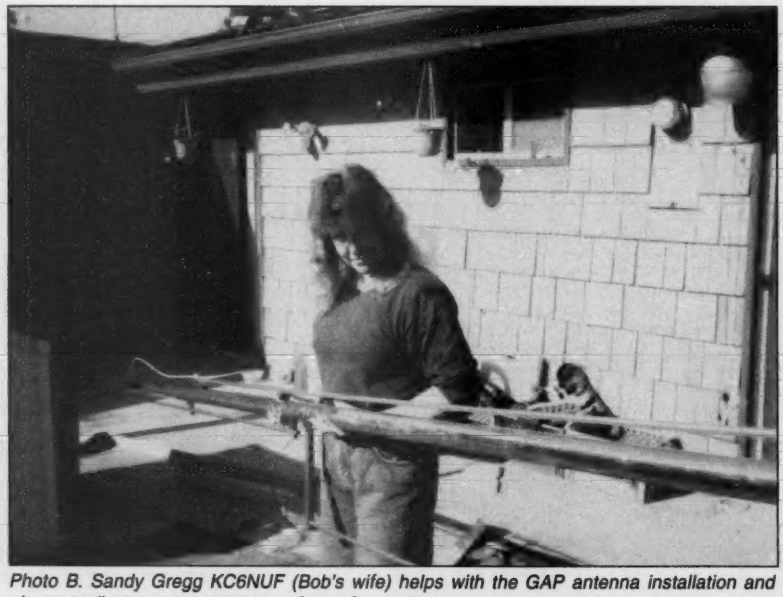

Photo B. Sandy Gregg KC6NUF (Bob's wife) helps with the GAP antenna installation and element adjustment to compensate for roof mounting.

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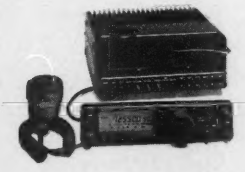

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Photo C. Justin Gregg KD6VGG puts the final touches on the top capacity hat before the Voyager goes into place.

80, and 160 meters, the much lower angle of radiation from the well-elevated dipoles with the Centaur baluns gave us a definite edge over your typical roof-top dipole installation. These typical installations are perfectly adequate for short- and medium-range, but not adequate to really work to the extent of "DX" with a full-length dipole elevated a minimum of one-quarter wavelength above the ground.

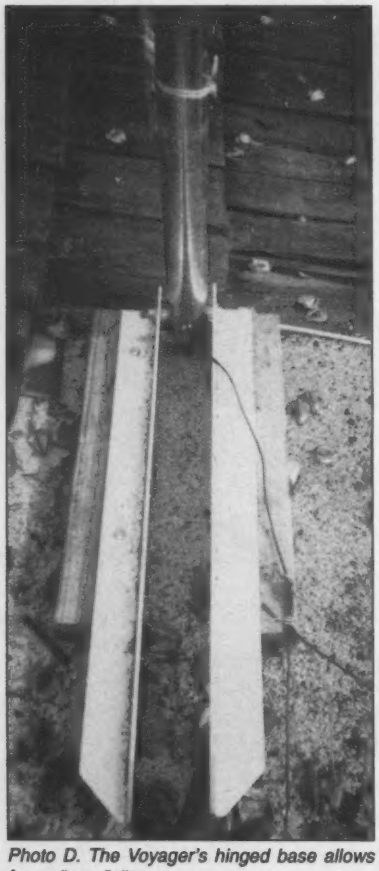

Photo D. The Voyager's hinged base allows for an "easy" tilt-up.

Conclusion on Dipoles

They work terrific when elevated at least one-quarter wavelength above the ground, with each side a natural one-quarter wavelength off of a professional balun, fed with any length, non-contaminating, big coax directly to your transceiver without the requirements of a manual or automatic antenna tuner. If you can operate right in the middle of that "sweet spot" where the dipole has natural resonance, you can minimize any tuner losses by going direct and keeping your coax "cold" to any standing waves coming back down the outside braid. The Centaur balun sees to that, too, even slightly off of operating frequency resonance.

The GAP Comparison

Rich at GAP Antenna Products makes a valid point that not all hams have 150-foot pine trees to suspend dipole feed points, and we should test the Voyager on the lower bands versus our dipoles. We ordered a Voyager DX that was shipped United Parcel Service to Bob's QTH in Fountain Valley, California.

"When you look at the box, it's hard to imagine that an aluminum vertical antenna that stands 45 feet tall is on the inside disassembled. And when I mean disassembled, I mean disassembled!" comments Bob Gregg AB6CH. Bob is no newcomer to putting antennas together—he regularly holds "antenna parties" for his General code class students who are upgrading from Technician to General class, and exploring the fabulous world of high frequency operating.

The GAP Voyager DX has been reviewed by several antenna experts, and most agree that size alone at 45 feet tall spells good performance on the lower bands when compared to popular 20-foot trap verticals featuring high impedance L/C networks to create resonance on popular ham bands without the use of a tuner. But the GAP Voyager does not use L/C traps, and resonance on 20 meters, 40 meters, 80 meters, and 160 meters is accomplished by capacitive loading by a labyrinth of elements, rods, wires, and a very large capacitive top-loading hat. The last time I remember seeing and working with a top-loading hat was back in the days of 2 MHz marine radio, and the top-hat was necessary to give us enough loading capability to run down the antenna PA coil to tap in for peak resonance.

It took us two days to get it up and flying. I will attest to the many recommendations in the instruction sheets on a fair amount of tension on the non-conductive guy wires, and the details on how important the mechanical interaction is with the performance of the dipole.

We fed the Voyager DX with the same type of non-contaminating RG-213 coax that were also feeding our dipoles. Each coaxial cable connector featured Teflon insulation to ensure no arc-over in wet weather. Three counterpoise wires, each 57 feet long, were also required for the proper operation of the GAP Voyager. The GAP was mounted on Bob Gregg's roof. A cast-iron vent pipe was the

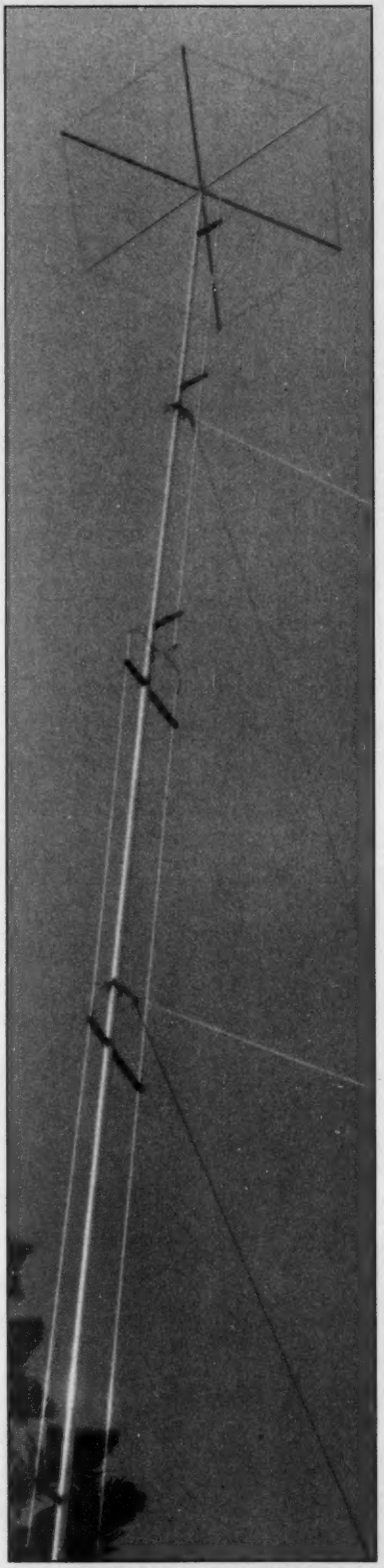

Photo E. The Voyager in place on the roof. Different measurements must be applied to roof mounting—40 meters needed a specific quarter-wave radial.

Photo F. Bob Gregg AB6GCH tests the Voyager with comparisons to dipoles up 100 feet.

perfect support to keep the base in place without fear of it slipping horizontally during the delicate antenna raising.

[Editor's note: For the purpose of this review, our intrepid reviewer installed the 45-foot vertical Gap Voyager on a rooftop. Please keep in mind that the manufacturer recommends ground mounting rather than roof mounting due to the Voyager's size.]

Once everything was in place, we took some roof measurements with the MFJ SWR bridge and found that we needed to lower the GAP back over on its hinged base for some fine-tuning of the 160 meter and 80 meter bands. We set 80 to 8775 kHz, and 160 to 1975 kHz. On 40 meters, we straddled the CW and voice portion of the band where Bob conducts regular code practice nets with students as far away as 1,000 miles.

Then came the big test—the GAP Voyager mounted up about 25 feet on the rooftop, versus the three half-wavelength dipoles hoisted well over 100 feet in the air at their feed points, with a slight droop to keep the dipoles within the property line. Would the Voyager blow the dipoles away?

Our first discovery was power-line noise. We used a professional Daiwa switch to go between the vertical and the dipoles, and at different times of day different power lines around the block would give us noise more on one antenna than the other, and then just the opposite at night. But we did find the lower-mounted vertical more susceptible to noise coming from surrounding houses than the well-elevated dipoles. And there were times that the dipoles picked up more power-line noise from distant arcing insulators than did the vertical. So the best bet was to have the capability to switch back and forth to minimize noise pick-up.

Ground-wave contacts gave both antennas an almost equal rating. Some said the dipoles were louder than the vertical, yet the vertical was sometimes heard better than the dipoles. We thought that polarization would make a major difference to different groundwave polarizations, but not necessarily so. We did confirm that ground-wave mobile stations heard the vertical better than the dipoles, and ground-wave base stations also running dipoles heard the dipoles better than the vertical.

When nighttime settled in, short-skip skywave stations heard both antenna systems ker-smash with signals well above S9. These stations from 300 miles to 800 miles away all commented that both the Voyager and the dipoles were almost equal in strength, and both were a lot louder than loaded verticals and low-level dipoles. However, there would now and then be a station that would comment that our system was not performing nearly as well as a lady ham down the street who had a series of dipoles just above roof level. And this makes sense—the lower to the ground you mount your dipoles, the higher the angle of radiation, and conceivably better signal to a short-skip station only a couple hundred miles away. So whenever you are comparing antennas, keep in mind that it is perfectly normal for nearby stations to sometimes get better signal reports off of a lower-mounted antenna system than you may have with a superb antenna system mounted up high where it should be for best DX.

"If you have capabilities of keeping the antenna tied down in big winds, a big vertical antenna is well worth its height."

As the evening wore on, signals to the edge of good DX skywave range began to pound in on both the well-elevated dipoles and the vertical. At times these DX signals would peak on the vertical, then at other times peak on the dipole. At no time could these signals be heard off of the low-elevated dipoles down the street.

Early in the morning, the vertical had two hours of better reception than the dipoles—sometimes hearing distant stations on 80 meters and 160 meters that the dipoles would only have heard as noise. And, at all times, signal reports exchanged with these distant stations were always commensurate with reception—the stronger you hear them, the stronger they will hear you on a particular antenna. However, as noise would come up from arcing power lines in the early morning fog, the dipoles would sometimes have an advantage over the vertical. The vertical Voyager was a hot antenna, but also picked up a lot more man-made noise because of its proximity to the nearby power feeds.

Conclusions

1. Bigger is better.

2. It's a close match between the vertical and the dipoles if the dipoles are at least one-quarter wavelength to one-half wavelength above the surface of the ground. That's not easy to do unless you have big trees.

3. The Voyager is an effective way to work DX with a roof top antenna only 45 feet tall down on 160, 80, and 40 meters. The Voyager won "hands down" on the lower bands when compared to other loaded and trap verticals half its size.

4. You'd better have understanding neighbors—the Voyager is a shocker when you see it for the first time up on the roof.

Which way to go? If you've got a lot of trees well over 100 feet around you, dipoles are an effective way of getting plenty of bang for just a few bucks with those bucks going to a quality balun. If you don't have big trees, consider a big antenna mounted on your roof with an elevated feed point. If you have capabilities of keeping the antenna tied down in big winds, a big vertical antenna is well worth its height.

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CIRCLE 345 ON READER SERVICE CARD

The Antenna Elevator

The closest thing to a skyhook.

by Frank DiStefano WB2DZF

No longer do you need to test your nerves and risk your life to repair nature's wear and tear on your beam antenna. Build this simple Antenna Sled and bring your problems down to earth.

Background

Ten years ago at a hamfest I acquired 70' of Rohn 45G tower. On top of this I put a Wilson System 40 triband beam antenna. This was no small project as this antenna has 10 elements with four full-sized 20 meter elements on a 26-foot boom, all weighing in at 80 pounds. After much strain and wild and dangerous gyrations, the antenna was put in place and proved to be an excellent antenna. Now this all sounds great, but what do you do when you have to make repairs or adjustments?

Initially I thought it would have been nice to have an elevator on the side of the tower to raise or lower the whole assembly (antenna, mast and rotator), but my climber had been eager to get the installation completed before winter set in, and I capitulated. That was a mistake. Within a short time the antenna showed a high SWR and it was intermittent in a wind: a loose connection, but where? So, the antenna just sat there for a few years until the ice storm of '91 finished it off! Part of the antenna fell to the ground and the rest was lowered in a somewhat controlled fall. I rebuilt the antenna but I had to come up with a way to raise it. I was not going to go through the previous experience again.

A Better Way to Raise It

I had to come up with something to lift the antenna to its mounting height, but the tower guys were a major obstacle. So I devised an "elevator" that allows the antenna to be raised by disconnecting the lower guys, raising the antenna, reconnecting the lower guys, disconnecting the upper guys, raising the antenna further and reconnecting the upper guys.

While there is some climbing to bolt the unit to the tower, the heavy work of wrestling the cumbersome beam is eliminated. The antenna can be brought down to within seven feet of the ground. This allows me to work on a small stepladder to make repairs and adjustments.

The unit is guided by two guide wires anchored at the top and bottom. These wires (or cables) are attached to a piece of angle bolted to the tower and passed through four guides welded to the elevator. With the elevator at its raised position it is bolted to the tower with eight 1-1/2" x 1/4" "U" bolts.

The elevator is raised to its position by means of a boat trailer winch fitted with 3/16" cable which runs through a block at the top of the tower, then back down to the bottom of the elevator. For the top bearing I made a bushing out of plastic. A bearing supplied by the tower manufacturer could be easily adapted if you prefer not to make your own. The mast is made of 2" pipe and the weight of both the antenna and the mast is carried by the rotator.

Appropriate threading of the feedline and rotator wires are key to allowing the antenna to be lowered within easy reach of the ground. Start by threading the feedline and rotator wires inside the tower until you reach the tower midpoint. Then bring all the wires outside of the tower and back down to your waiting antenna. Now, hookup and testing can be done on the ground.

Now you are ready to lift your assembly to the top of the tower. When in place, you can tape or wire-tie the wires to the tower.

I much prefer the guyed tower to the free-standing tower because I don't want any concrete to contend with when installing or removing the tower at a later date. The elevator is made of 3/16" x 2" angle iron and is of welded construction. While you could

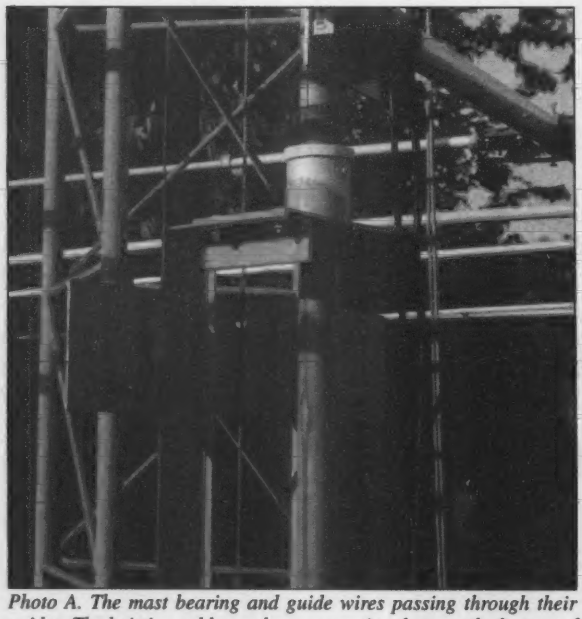

Photo A. The mast bearing and guide wires passing through their guides. The hoisting cable can be seen passing down to the bottom of the elevator.

Photo B. The rotator and guide wires attached to their eye bolts and passing through the guides on the elevator.

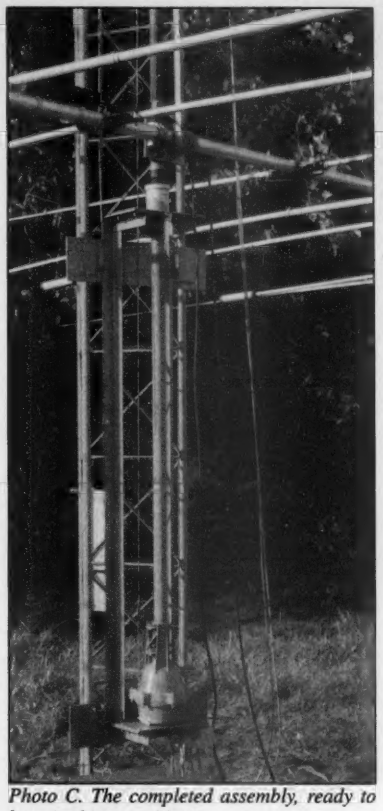

Photo C. The completed assembly, ready to be raised into position.

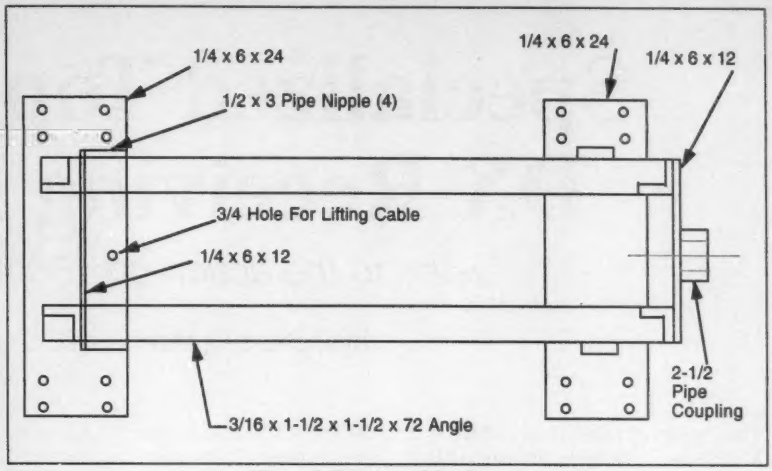

Figure 1. Top view of the elevator.

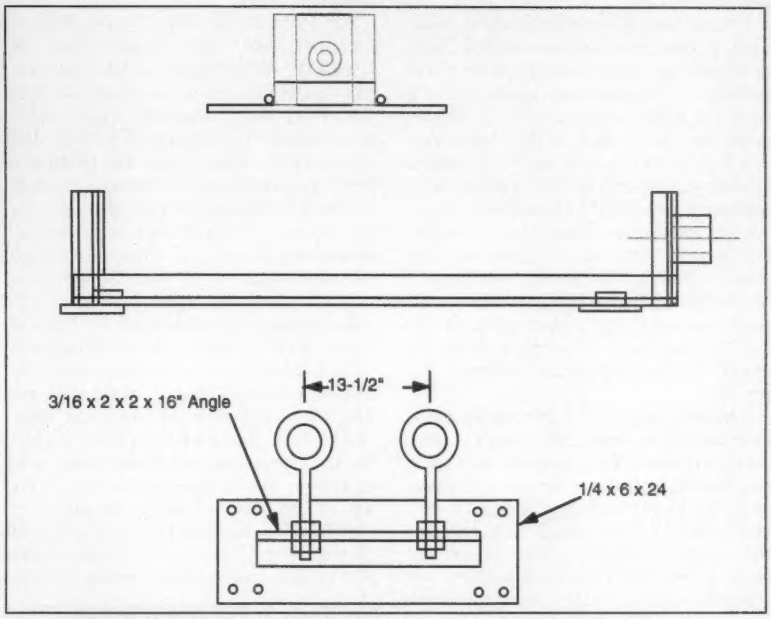

Figure 2. End view (top), side view (middle), and guide cable anchor (bottom).

bolt it together, it seems everyone knows someone with a welder. Or, it should not cost much to hire someone to do it.

Figures 1 an 2 show the dimensions I used, but these can be altered to suit your tower and rotator.

The antenna has been up for about one year now and everything is working fine. If I have to lower the antenna, it should take about an hour and require only two people working at a leisurely pace, *safely!*

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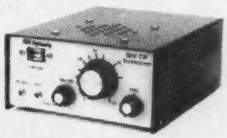

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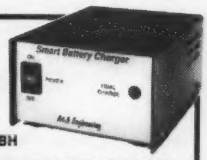

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Specialized Top-Band DX Receiving Loop

Listen to the action on 160 meters.

by Richard Q. Marris G2BZQ

The "top-band" covers from 1.8 MHz to 2 MHz and is, therefore, the only amateur transmitting band in the MF spectrum (300 kHz to 3000 kHz).

On top-band it is not uncommon, when using a conventional antenna, to hear European stations working traffic with North America, yet all one can personally hear is a weak signal deep in the typical high ambient noise level, or no signal at all. Many therefore build a simple loop receiving antenna consisting of several turns of wire around a framework, resonated by a variable capacitor, and transformer-coupled to the receiver with a single wire turn alongside the main resonant winding. The results, though possibly better, are often disappointing, with weak signals and high ambient noise. If you add a preamplifier to boost the weak signals and it will also amplify the ambient noise pro rata.

Yet with a properly designed MF loop it is quite possible to comfortably hear, and read, previously inaudible transatlantic and other DX signals. Such a loop has to be designed to give peak performance for just the 200 kHz between 1.8 MHz and 2 MHz, resisting the temptation to take in as wide a frequency range as possible. The loop dimensions are somewhat dictated by the domestic environment.

The top-band loop antenna, properly designed, can produce good reception of transatlantic signals which otherwise cannot be identified, or heard, with the available conventional antenna.

History

The loop receiving antenna has been around since the earliest days of wireless in connection with DF (direction finding) requirements, on oceangoing vessels in those days when the ocean liner, not the airliner, reigned supreme. It is therefore useful to study old relevant textbooks covering the 1920s to 1940s, such as Terman* and *The Handbook of Technical Instruction for Wireless Telegraphists**. By far the best is the 1938 edition of *The Admiralty Handbook of Wireless Telegraphy*.* This two-volume book was a standard training manual used throughout the armed services, merchantile marine colleges, and many other training establishments. The DF section, "T," has never been surpassed for locating basic information on the principles and properties of DF and loop antennas.

MF loops are divided into two distinct types: the "box" form (Figure 1) and the "pancake" form (Figure 2), which is now more commonly known as the spiral loop. They both give a theoretical "figure-eight" polar diagram of reception (Figure 3). The *Admiralty Handbook* states that in the box form "the loops are of the same dimensions, but not coplanar, and are equivalent to a single loop of 'n' times the area in a plane parallel to themselves, plus a loop at right angles of area equal to half the area of the vertical side of the box frame. Hence *zero signals will not be obtained* when the frame is exactly at right angles to the line joining it to the transmitter." This is contrary to generally held assumptions. Also, "In the pancake form the total EMF is the sum of the separate EMFs in the loops, these being proportional to the dimensions in each case. It is equivalent to one Loop whose area is the sum of the individual areas, and *gives zero signals*, when the plane is at right angles to the transmitters." More recent textbooks appear to gloss over these statements, and seldom mention the spiral loop. Too difficult to make?

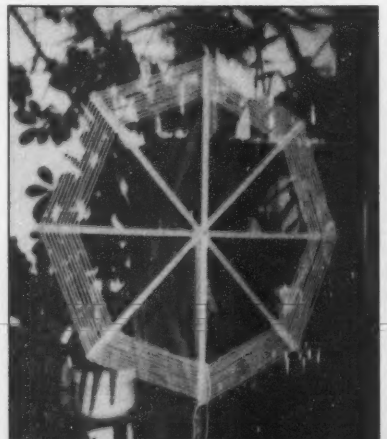

Photo A. The top-band receiving loop.

The above indicates that at MF frequencies the pancake, or spiral, loop should be superior to the box loop. The loop can be any symmetrical shape, e.g. square, diamond, triangular or circular. The ideal shape appears to be circular, and is also the most difficult to construct in spiral form. In practice, a near circle can be obtained by using an octagonal framework. The size of the loop will, in practice, be influenced by the domestic operating (and storage) space available. Furthermore, textbooks and personal experiments indicate that the variable capacitor should be set at near minimum capacity, with maximum wire turns, to obtain maximum signal strength and minimum ambient noise at the target frequency (i.e. 1.8-2.0 MHz). Rotation of the loop will also reduce or eliminate adjacent interfering signals to the one being read.

Loop Description

The loop circuit shown in Figure 4 shows an 11-turn spiral loop in octagonal shape, which is very close to circular in shape, with an outside diameter of 30 inches. The turns are held apart by threading through 12-way 2-amp polythene terminal blocks, which are a convenient 5/16" apart, center to center, thus reducing the proximity effect. The loop is brought to resonance by a balanced circuit 2 gang x 500 pF per section variable capacitor (C3 + C4) with 150 pF capacitors C1 and C2 in series. These 2 gang x 500 pF variable capacitors are readily available from suppliers, on the surplus market, or salvaged from an old MW/LW domestic radio. Built-in trimmers should be removed if fitted. When C3 + C4 plates are not more than 5% enmeshed, 2 MHz is resonated. Tuning is smooth and easy with a large 3" diameter instrument knob—no slow-motion drive is required.

Coupling to the receiver's 50-ohm impedance input is via C5 (470 pF) and a short length of RG58 feedline. Originally C5 was a variable capacitor to adjust the degree of coupling. *Under*-coupling is indicated by a narrowband weak signal, and *over*-coupling by a double-hump wideband effect. The optimum coupling is just under the over-coupling

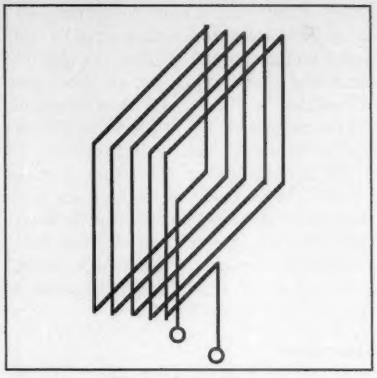

Figure 1. Box form.

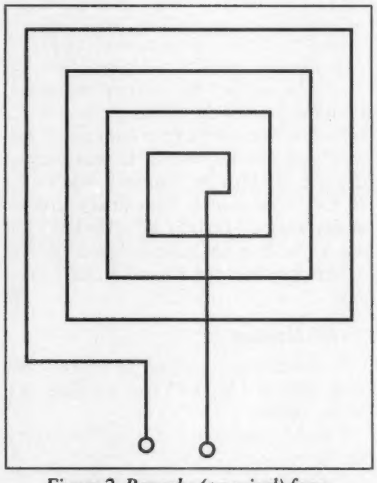

Figure 2. Pancake (or spiral) form.

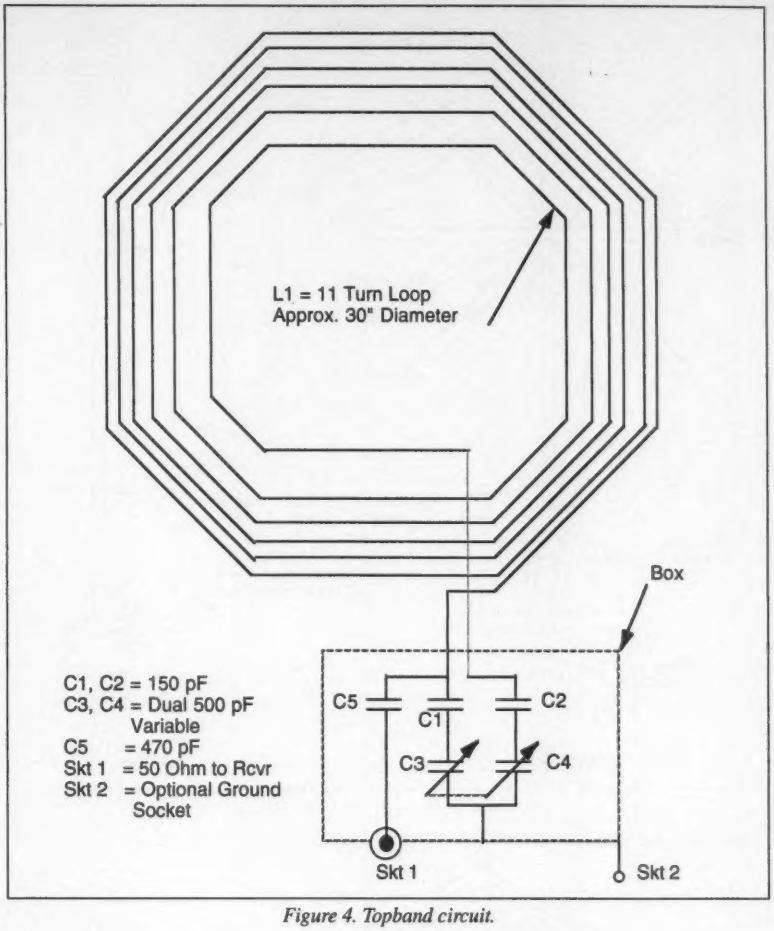

Figure 4. Topband circuit.

point where the double hump turns into a single peak. Conveniently, this worked out at 47 pt (C5). Anyone using a 300-ohm twin feedline (or other impedance) should revert to a variable C5 to arrive at the necessary capacity value. Though an optional grounding socket has been shown (Skt 2), no real advantage is apparent. Using an earth connection to a domestic water pipe increased the ambient noise, and another earth connection slightly decreased it. By far the best method appears to be making an earth connection to the receiver adjacent to the low impedance coaxial input. The whole of the tuning unit must be enclosed in a metal box.

Performance has been very gratifying in as much as transatlantic CW signals are quite clearly heard and read with a sensitive receiver, whereas they cannot be heard at all or be barely heard on a conventional wire antenna. A preamplifier has not been found to be necessary, as the whole loop is peaked over a mere 200 kHz band (1.8-2 MHz). Rotation of the loop reduces/eliminates interference from other stations, and local man-made noise.

Construction

The mechanical structure (Figure 5) consists of four lengths of good dry timber, 30" x 5/8" x 1/4", with a hole drilled in the center of each where glue is applied and the lengths secured with a bolt, a nut and washers, adjusting the limbs to 45 degrees as shown. At the end of each limb a 12-way 2-amp polythene terminal block is fitted. These blocks are used to secure the loop turns in place, approximately 5/16" apart, thus providing an 11-turn octagonal spiral winding, which is as near the ideal circular shape as possible.

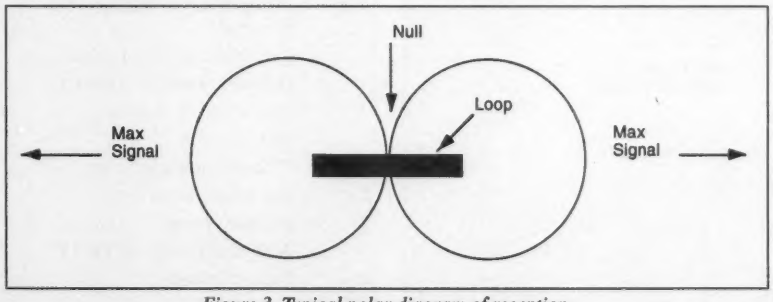

Figure 3. Typical polar diagram of reception.

The loop winding (Figure 6) consists of PVC-covered hook-up wire (7/0.2 mm with an overall outer diameter of 1.2 mm). Commence the winding at the bottom outside terminal block insert and proceed counterclockwise, in a spiral, terminating at the inner insert. The terminal block insert grub screws should be tightened about once per turn to hold the winding rigid. Leave sufficiently long wire tails for later connection to C1 and C2.

The above eight-prong wound loop frame is bolted to one end of a 23" x 0.8" x 0.8" vertical timber support (Figure 5), the other end of which is screwed and bracketed to a 12" x 9" x 1" base. For the base, a gray inverted TV snack tray was used, which lost its original identity and provided an attrac-

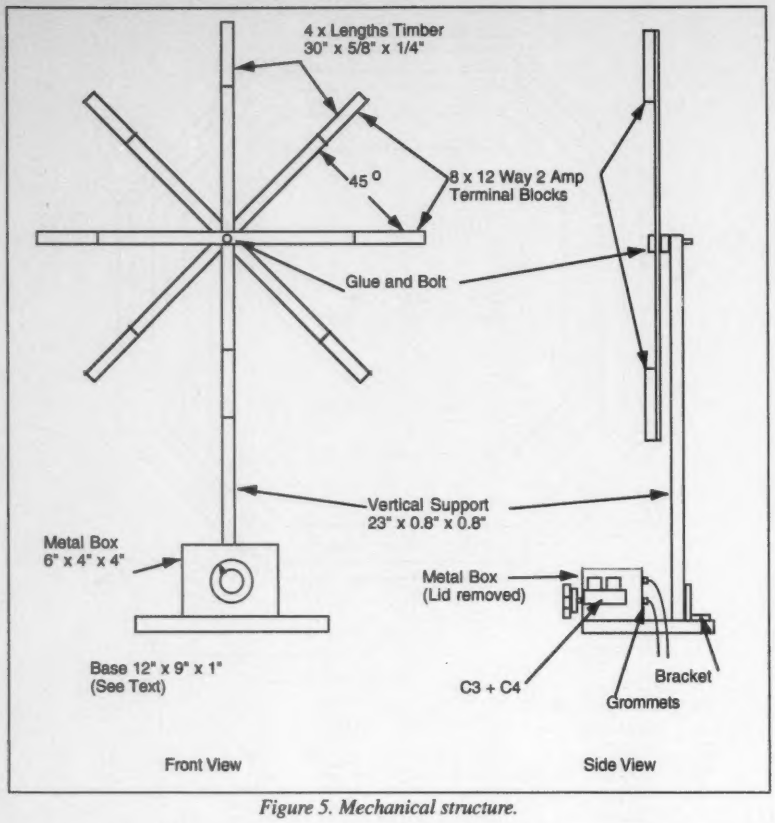

Figure 5. Mechanical structure.

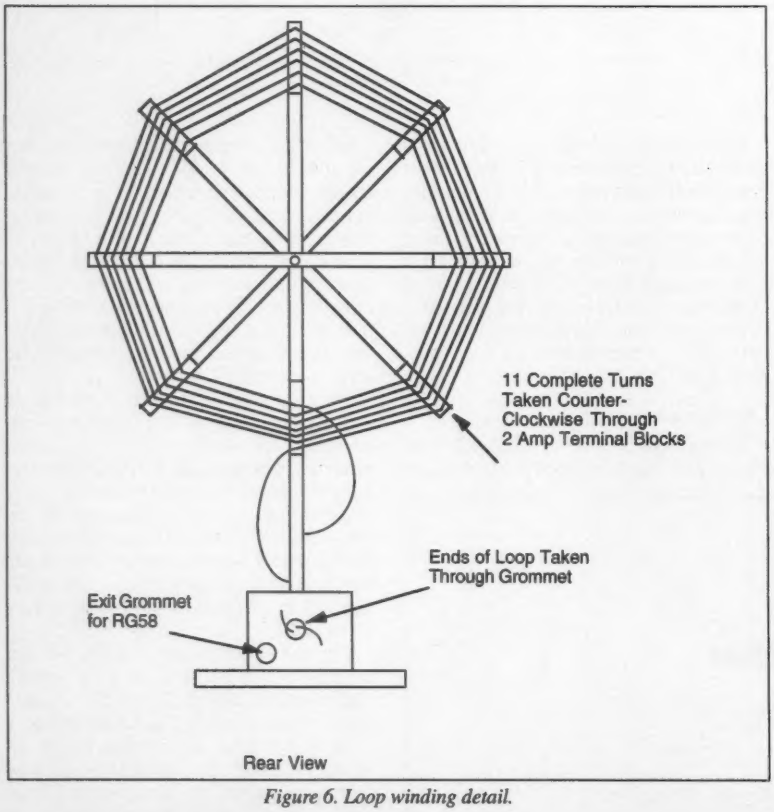

Figure 6. Loop winding detail.

tively-shaped molded base. As the base is 1" deep, it is weighted with a strip of 3/4" wood underneath. Other base construction ideas will come to mind. The metal box used measures 6" x 4" x 4", and has a removable lid mounted as shown in Figure 5. The box size is not critical. The variable capacitor C3 + C4 is mounted on the front panel as shown. The two ends of the loop are taken through an insulated grommet in the center rear of the box (Figures 5 and 6). Sixty inches of RG58 coaxial feedline is taken through a rear grommet, or via a coaxial socket to the receiver (Figure 6).

Operation

With the loop connected to the receiver, tune the latter to 2 MHz and rotate C3 + C4 to maximum signal, which should occur with the rotor plates not more than 5% enmeshed. Repeat this procedure at 1.8 MHz. When tuned to a signal, the loop should be rotated for maximum signal. Rotation either side of this point will reduce/eliminate interference from other stations, and specific manmade interference. You will find that the loop will tune to the HF end of the medium wave broadcast band but performance starts to fall off below 1700 kHz, as the loop has been designed for peak performance between 1.8 MHz and 2 MHz only.

***Useful Reading**

1. *Handbook of Wireless Telegraphy 1938*, published by His Majesty's Stationery Office, London.

2. *Radio Engineering* (Second Edition) by F.E. Terman Sc.D., 1937.

3. *Handbook of Technical Instruction for Wireless Telegraphists* by H.M. Dowsett & L.E.Q. Walker, Seventh Edition, 1942.

4. *Measurements in Radio Engineering* by F.E. Terman, First Edition 1935.

5. Others: *Antennas* by Kraus and *The ARRL Antenna Book*.

Parts List

C1,C2	150 pF silver mica capacitors
C3 + C4	2 gang x 500 pF per section robust variable capacitors
C5	470 pF silver mica capacitor
Skt 1	Coaxial feedline RG58 60" long maximum
Skt 2	Optional earth-connecting socket
Wire	PVC hook-up wire 7/0.22 mm and 1.2 mm o/d
8	2 amp polythene terminal blocks
4	Dry timber lengths 30" x 5/8" x 1/4"
1	Vertical support: dry timber 23" x 0.8" x 0.8"
1	3"-diameter instrument knob
1	Box, typically 6" x 4" x 4", with removable lid
1	Base, approximately 12" x 9" x 1"
2	Plastic grommets

DAYTON hamvention® '95

April 28, 29,30, 1995

General Chairman, Ken Allen, KB8KE — Asst. General Chairman, Dick Miller, N8CBU

✷ Giant 3 day Flea Market ✷ Exhibits ✷ Activities for the Non-Ham

When and Where
April 28, 29 and 30, 1995; Dayton, Ohio at Hara Arena

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In order to have time to return tickets to you, we must have advanced reservation orders postmarked not later than April 8 (USA) or April 1 (Canada). Tickets will not be mailed before January 15th, 1995. Ticket requests that are received **AFTER** the deadline will be processed and **HELD** for pick-up at Hara Arena. Tickets can be picked up beginning Thursday, April 27 at 8:00 a.m.

Flea Market
Flea Market Tickets (valid all 3 days) will be sold IN ADVANCE ONLY. No spaces sold at gate. A maximum of 3 spaces per person (non-transferable). Electricity is available in a portion of the last Flea Market row for $40 additional per space. Rental tables and chairs are not available in the Flea Market. Vendors ***MUST*** order an admission ticket for each person when ordering Flea Market spaces. Please send a separate check for Flea Market space(s) and admission ticket(s). Spaces will be allocated by the Hamvention committee from orders received by February 1. Please use 1st class mail *only*.

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Build an Efficient HF Mobile Antenna

An electrically and mechanically sound design is offered, with easy band change coils.

by Frank Kamp K5DKZ

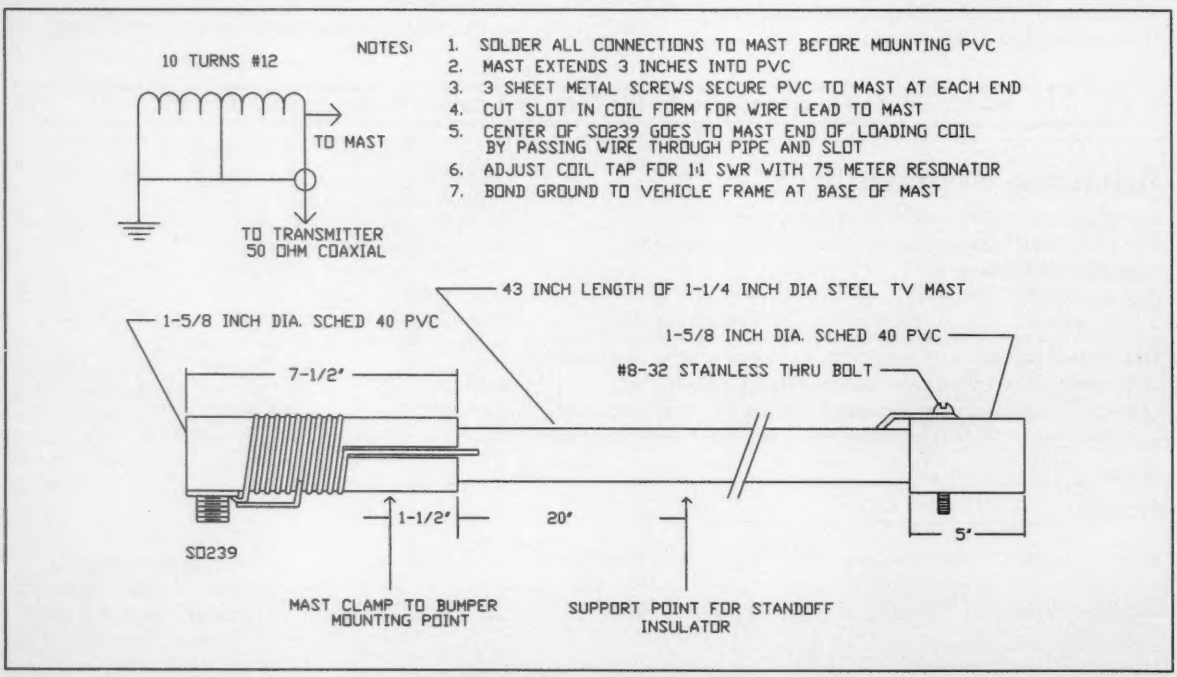
Short, coil-loaded antenna designs are all compromises when compared to full-sized antennas. Resistance losses in loading coils and low input impedances (typically 5 to 20 ohms) are the main efficiency-robbing factors. Efficiency can be optimized by using capacitive top-loading and high-Q loading coils. Top loading reduces the number of turns needed in the loading coil. Air-wound coil designs that utilize #12 or heavier wire will maximize Q and efficiency. Spiral-wound whips are also favored alternatives because their input impedance is relatively high, typically around 20 ohms. A design optimized for efficiency alone might take on the form of a large-diameter, spiral-wound, six-foot coil of heavy wire topped with a three-foot diameter capacity hat and three-foot whip. Such a design would work well electrically, but would pose a significant mechanical challenge and complicate band switching.

My past mobile activities have employed a standard center-loaded whip using interchangeable resonators for band changes. Tuning within the band is accomplished by adjusting the length of the whip at the top of the resonator. This type of antenna works reasonably well on 20 and 15, but becomes top-heavy and flimsy on 75 and 40 meters when used with most standard mobile masts. A single insulated base bumper mounting, along with a heavy center-loading coil, result in a radiator that does not always remain vertical at highway speeds. The "store-bought" version I used over a period of 15 years also developed questionable mechanical and electrical integrity. Connections to the mast were mechanically swedged instead of brazed, soldered or welded.

I needed a mechanically and electrically sound, vertical, all-band antenna. The main bands of interest were 75, 40, and 20 meters. Overall height was to remain under nine feet, with the upper three feet being a flexible whip. I wanted a design optimized for efficiency and easy band changing, but it also needed to be practical. Use of commonly available materials was an important factor in keeping costs down. The end result is a very stable, easily-mounted antenna that uses quick change resonators for band changes. The resonators are pre-tuned for the phone portions of each band and use a common three-foot whip. Only the resonators need be swapped to accomplish a band change.

The Resonators

The 75 meter resonator covers 3.7 through 4.00 MHz in 12 steps. The bandwidth of each coil tap is 20 kHz between 2:1 upper and lower SWR points, and 30 kHz between 3:1 upper and lower SWR points. Fine-tuning at each coil tap is done by adjusting the length of the three-foot whip. Careful adjustment will bring the SWR to 1:1 consistently after the matching coil tap is adjusted for a 50-ohm


NOTES:
1. SOLDER ALL CONNECTIONS TO MAST BEFORE MOUNTING PVC
2. MAST EXTENDS 3 INCHES INTO PVC
3. 3 SHEET METAL SCREWS SECURE PVC TO MAST AT EACH END
4. CUT SLOT IN COIL FORM FOR WIRE LEAD TO MAST
5. CENTER OF SO239 GOES TO MAST END OF LOADING COIL BY PASSING WIRE THROUGH PIPE AND SLOT
6. ADJUST COIL TAP FOR 1:1 SWR WITH 75 METER RESONATOR
7. BOND GROUND TO VEHICLE FRAME AT BASE OF MAST
10 TURNS #12
TO MAST
TO TRANSMITTER 50 OHM COAXIAL
43 INCH LENGTH OF 1-1/4 INCH DIA STEEL TV MAST
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1-5/8 INCH DIA. SCHED 40 PVC
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MAST CLAMP TO BUMPER MOUNTING POINT
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Figure 1. Mobile mast construction detail.

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Photo A. 75 meter mobile resonator mounted on the HF mobile antenna mount.

match to the transmitter. Ordinarily, high-Q coils of this type will have a tendency to drift in a mobile environment. The rigid overall construction of this antenna keeps the radiator on frequency.

On-the-air tests show that this is an effective 75 meter antenna. During a recent Sunday morning schedule with a station 200 miles away, my mobile installation received an S-7 signal report. This compares favorably with the S-9 plus 10 dB report I received using the fixed station at the same time, when you consider the conditions. I was running 1,200 watts PEP to an inverted vee up at 60 feet in the fixed station configuration. My mobile setup was limited to 100 watts PEP and the vehicle was sitting in the driveway surrounded by 50-foot trees on all sides.

The 40 meter resonator covers 7.15 through 7.30 MHz without the need for taps. Its bandwidth is 170 kHz between 3:1 upper and lower SWR points and 100 kHz between 2:1 upper and lower SWR points. It is somewhat more efficient than the 75 meter resonator.

The 20 meter resonator covers the entire band from 14.0 to 14.350 MHz with a single untapped coil. The actual 3:1 upper and lower SWR points are 14.0 to 14.4 MHz, and the 2:1 points fall at 14.05 and 14.3 MHz. The bandwidth increases to 300 kHz because the physical length of the antenna becomes a larger percentage of what is required for a quarter wavelength resonator on that band.

Mast Construction

See Figure 1. The bottom portion of the mast is a 43" length of 1.25" diameter steel TV mast. I realize this is overkill but the TV mast diameter provides a nice slip fit with 1.5" schedule 40 PVC pipe. A 4.5" section of PVC pipe is attached to the upper part of the steel mast, with four self-tapping sheet metal screws and serves as the mounting for the base of the resonators. A 7.5" length of PVC pipe is attached in the same way to the bottom of the steel mast. The bottom section of PVC serves as a coil form for the matching coil, an insulator for the bottom antenna mount, and a convenient place to install an SO-239 connector for the feedline connec-

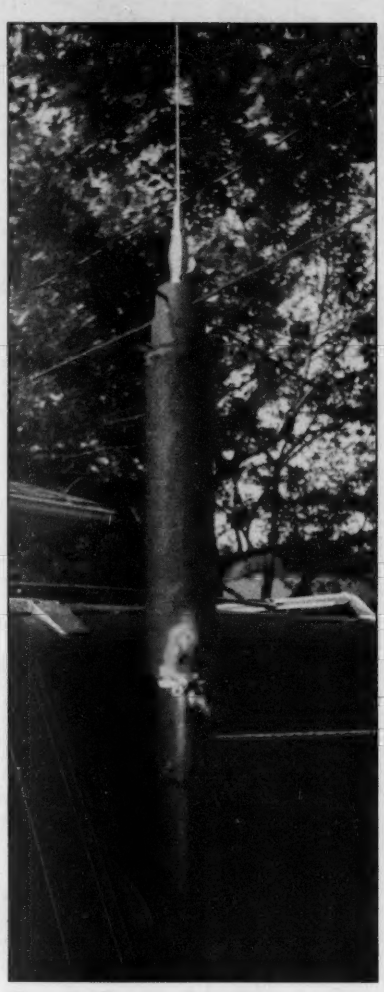
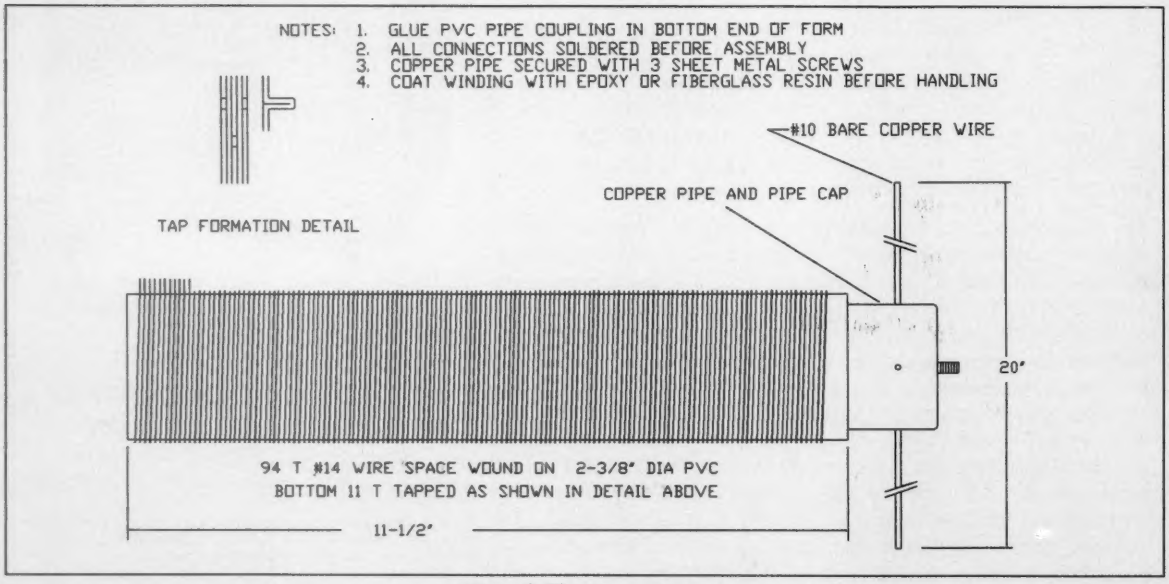


Photo B. Close-up of the 75 meter resonator.


NOTES: 1. GLUE PVC PIPE COUPLING IN BOTTOM END OF FORM
2. ALL CONNECTIONS SOLDERED BEFORE ASSEMBLY
3. COPPER PIPE SECURED WITH 3 SHEET METAL SCREWS
4. COAT WINDING WITH EPOXY OR FIBERGLASS RESIN BEFORE HANDLING
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COPPER PIPE AND PIPE CAP
TAP FORMATION DETAIL
20"
94 T #14 WIRE SPACE WOUND ON 2-3/8" DIA PVC
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11-1/2"

Figure 2. 75 meter resonator.

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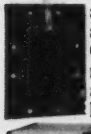

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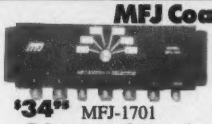

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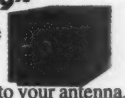

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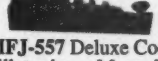

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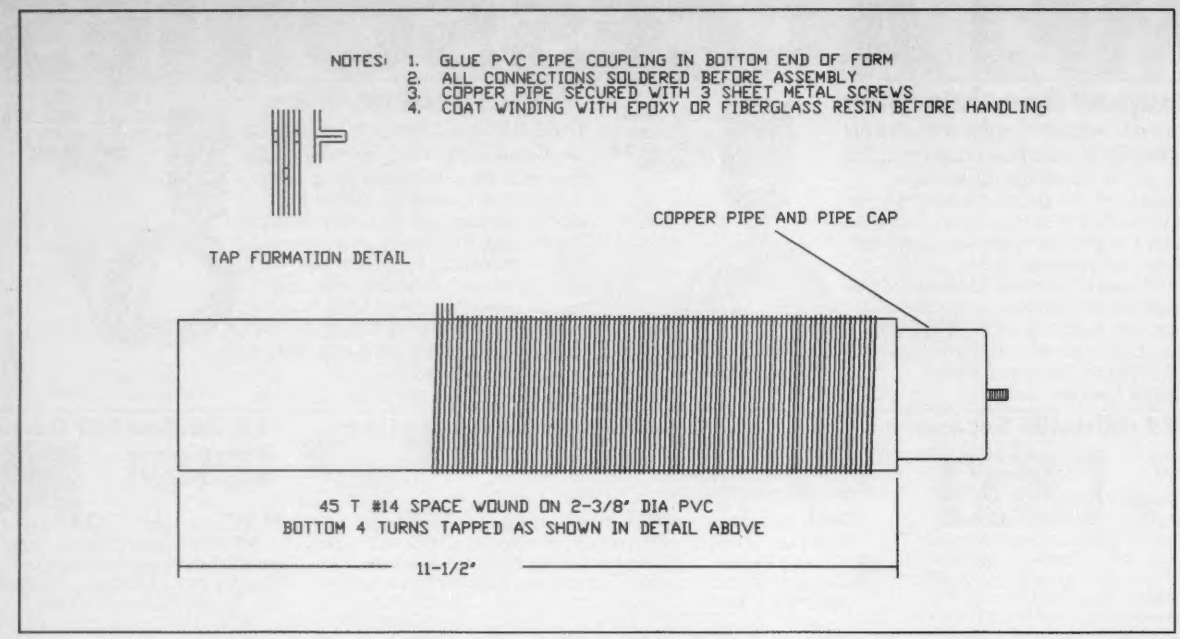
NOTES:
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4. COAT WINDING WITH EPOXY OR FIBERGLASS RESIN BEFORE HANDLING
TAP FORMATION DETAIL
COPPER PIPE AND PIPE CAP
45 T #14 SPACE WOUND ON 2-3/8" DIA PVC
BOTTOM 4 TURNS TAPPED AS SHOWN IN DETAIL ABOVE
11-1/2"

Figure 3. 40 meter resonator.

tion. Electrical connection to the mast is made using heavy copper braid removed from lengths of scrap coax. The braid is soldered to the steel mast. You will need a large soldering iron or propane torch to make these connections and you will want to solder the braid in place before permanently installing the PVC sleeves. Cut a slot down three-quarters of the length of the lower PVC sleeve. This allows the boom-to-mast mounting clamp to compress the sleeve tightly around the lower mast section. It also provides a convenient way to bring the braid down the center of the pipe, where it is soldered to the center of the coaxial connector. The upper, ungrounded end of the matching coil is also soldered to the braid.

The matching coil is 10 turns of #12 wire spaced one-wire in diameter between turns and located between the coax connector and the electrical connection to the mast. The lower end of the matching coil is soldered to the flange of the coax connector. A second length of heavy copper braid is soldered to the coax connector flange and grounded to the frame of the vehicle. These solder connections are made using a propane torch and before mounting the coax connector to the PVC pipe. You will want to use a Teflon-insulated coax connector that will withstand the heat of soldering. Use standard 4-40 hardware to mount the connector. Stainless steel hardware is preferred but not absolutely necessary if the ground connections are soldered. Soldering directly to the flange results in better long-term electrical connections than can be achieved using solder lugs and hardware. The ground connection to the vehicle frame should also be soldered.

Wind the matching coil onto the PVC before mounting it to the mast. Self-tapping screws can be used to secure the beginning and ends of the winding but should not be relied on as a permanent solution. Several vertical bands of epoxy will keep the coil in place. I used Fiberglas resin to fully encapsulate the coil after finding the proper tap for a 50-ohm impedance match.

The bottom part of the antenna is mounted to the steel bumper of the vehicle using a common antenna mast clamp. Two holes are drilled through the bumper for the U-bolt. This provides an inexpensive and rigid mounting. The mast will require a second mounting for stability. This attachment should be about two feet up from the lower mount. I used a 2.5"-wide length of heavy printed circuit board material. After the copper was chemically removed, I drilled one end of the PC board material to match the bolt pattern found on the inside wall of the tailgate mount of my truck. After adjusting the mast so that it was perfectly vertical, I drilled the other end of the PC board and mast together to receive a #10-32 through-bolt. The bolt passes through the mast and secures the PC board spacer. Almost any rigid insulating material can be used for this spacer but I would advise against using Plexiglas. Plexiglas gets brittle with age and will eventually fail. Polycarbonate would be an ideal alternative. This mounting is most suitable for installation on a truck or van. If done properly, it will not interfere with the movement of the tailgate or hatchback.

Resonator Construction

Two-inch-diameter schedule 40 PVC pipe is used as a coil form for the resonators. Its actual outside diameter is just under 2.5". Its inside diameter provides a slip fit for the outside diameter of coupling sleeves used with the 1.5" diameter PVC pipe. The coupling sleeve is glued to the inside of the coil form using PVC cement. The outside diameter of the coupling sleeve is not a critical dimension in the manufacture of the sleeve and may vary from brand to brand; all of them will fit inside the coil form. However, the fit may vary from loose to very sloppy and may require additional PVC material to take up the slack. If needed, thin strips of PVC material can be cut from a scrap of pipe and used to improve a sloppy fit between the coupling and the coil form. A press fit is not needed or desirable as it could fracture the coil form, but a close fit is necessary in making a permanent assembly using the PVC cement. The press fit of the coupling sleeve to the 1.5" PVC pipe is all that is necessary to keep the resonators in place on the mast, even at highway speeds. This mounting is secure and allows easy removal of the resonators.

75 Meters

See Figure 2. A 12" length of coil form is needed for the 75 meter resonator. The resonator consists of 93 turns of #16 solid copper enameled wire wound onto the form and spaced approximately one wire diameter apart. The spacing is not overly critical, but avoid close-winding the coil. Closer spacing will result in more inductance per linear inch, requiring fewer turns. To space the turns, I use braided nylon twine that is slightly larger in diameter than the wire. The wire and twine are wound simultaneously onto the form.

After the winding is complete, carefully remove the twine. You need about 60 feet of #16 wire. Before you start, make sure it has no kinks in it. The surest way of keeping kinks out of it when you wind the coil is to

Continued on page 50

Where's the Loop?

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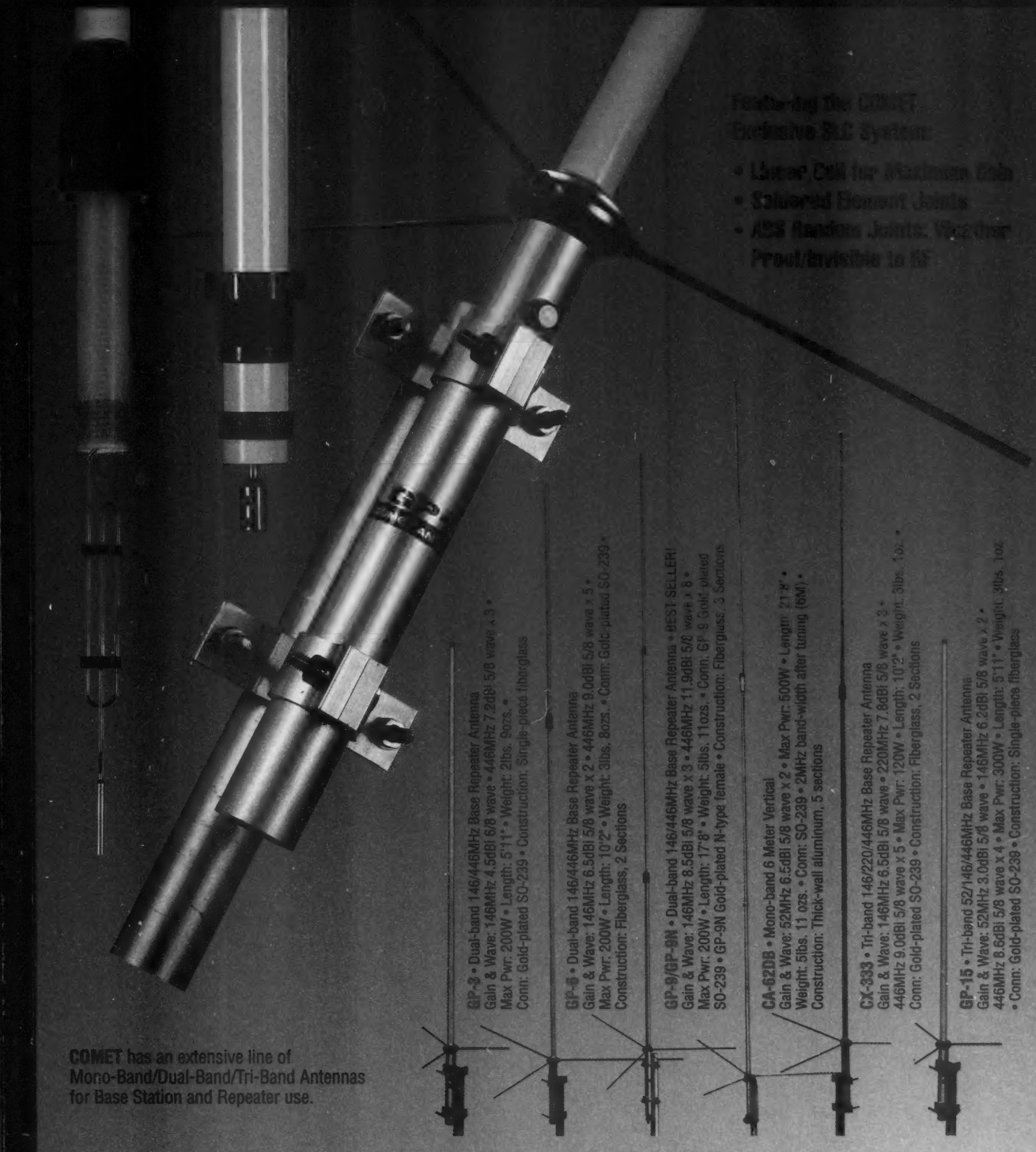

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Build an Efficient HF Mobile Antenna

Continued from page 46

lay the wire straight out into a yard. If it does have kinks in it, remove them by tying one end of the wire to a fence post and giving the other end a few good yanks. The 11 taps are located at the bottom end of the coil form where it attaches to the mast. Each tap is staggered from the other by approximately an inch so they don't end up bunched up on top of each other. Before worrying with the taps, complete the coil winding and use epoxy to secure all but the bottom 11 windings. After the epoxy cures (overnight!) unwind the unsecured windings. Scrape the enamel completely from a 1" length of wire and bend it down on top of itself to form a closed loop about 0.25" long. We want the copper in the loop to be bright and shiny because we will later fill the loop with solder. When done, secure the tapped windings with epoxy.

Leave enough wire at the end to install the large solder lug that will be screwed down against the #10-32 stainless steel through-bolt we will install at the top of the mast. This through-bolt is the only mechanical connection in the antenna functioning as an electrical termination. It ties the bottom of the coil to the end of the copper braid from the top of the mast, and is required to allow removal of the resonator. It uses a wingnut fastener. An additional length of wire from the solder lug is bent back up the coil form and soldered to the desired coil tap. This is a semi-permanent connection so, before final assembly, make sure it is in the frequency range you will be using. I don't recommend alligator clips, sliding contacts, or miniature banana plugs; a soldered connection will outperform all of these alternatives.

Glue another 1.5" PVC coupling sleeve into the top end of the coil form. Self-tapping sheet metal screws secure the copper top hat and whip mount into the sleeve. The top hat and whip mount are made from 2"-long 1.5"-diameter copper pipe and pipe cap. Drill the pipe cap in the exact center of its top, and install a bolt here that matches the size and tread requirements of your spring loaded whip. Drill additional holes around the pipe and cap assembly at 90-degree intervals. Insert two lengths of #10 solid copper wire 21" long through these holes and center them on the assembly. Then, using a torch, solder the entire assembly. Don't try to solder just a portion of the assembly; copper is too good a conductor of heat to allow that. All connections will have be soldered at the same time. The top wire from the resonator coil is also soldered to this assembly. The wire can be kept in place by wrapping it around one of the top hat radials prior to soldering. All soldering should be done prior to installing the assembly into the PVC coupling.

40 Meters

See Figure 3. The 40 meter resonator is built like the 75 meter resonator. The minimum required coil form length is eight inches. Space-wind a total of 44 turns of #12 bare copper wire onto the form and secure it with epoxy. Approximately 33 feet of wire is required. The same nylon spacing twine used on the 75 meter coil can be used here, but a crossed-wire top hat is not used. Otherwise, the whip mounting is the same as on the 75 meter resonator. The 40 meter coil becomes resonant at 7254 kHz with the bottom two turns shorted. Each turn of the coil shifts the resonant frequency by about 200 kHz. The

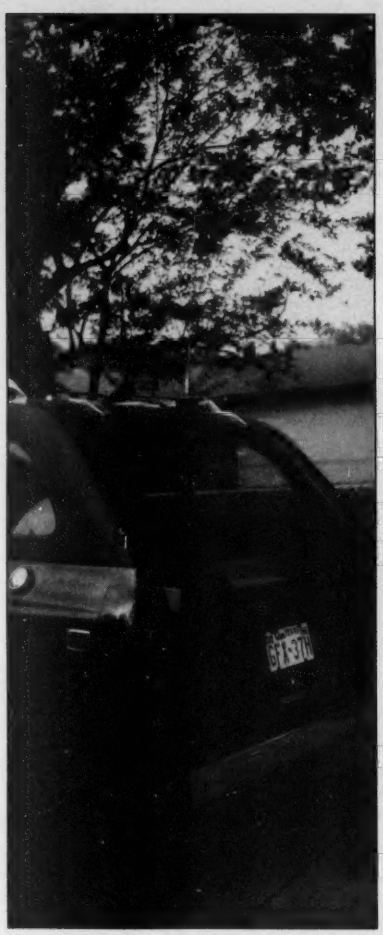
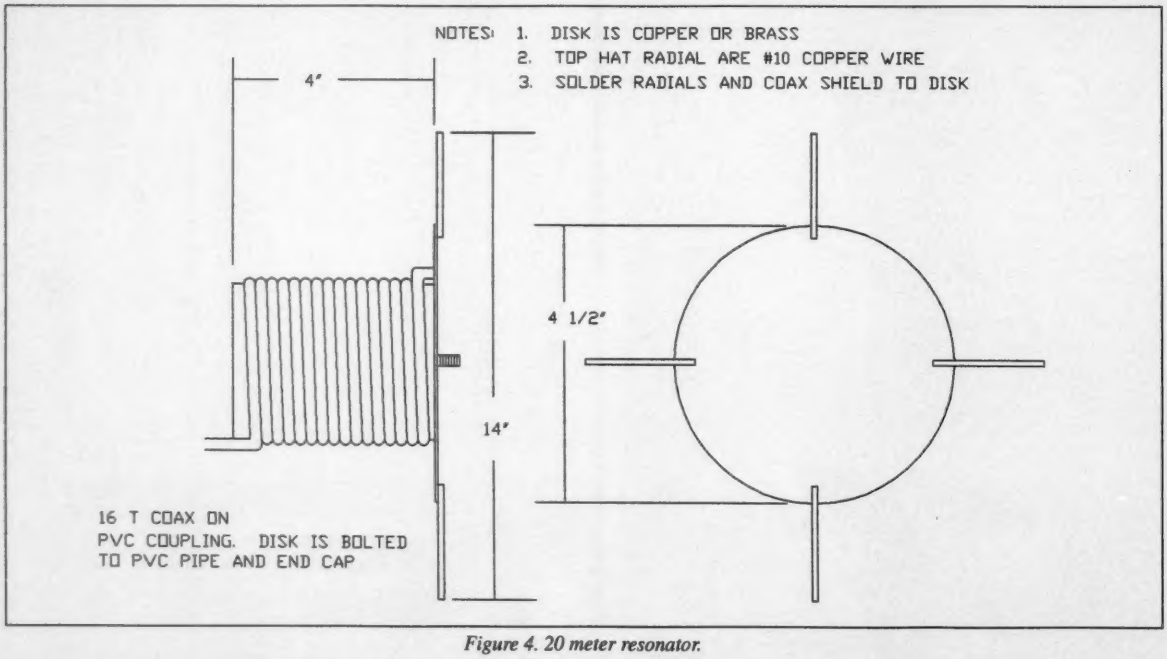


Photo C. 20 meter resonator mounted on the mobile mast.


NOTES:
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3. SOLDER RADIALS AND COAX SHIELD TO DISK
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TO PVC PIPE AND END CAP

Figure 4. 20 meter resonator.

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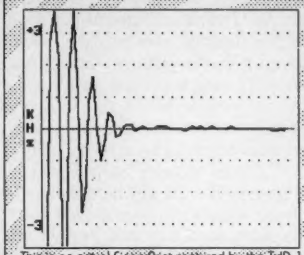

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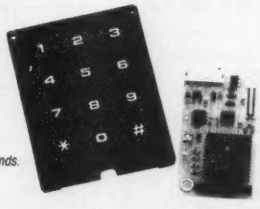

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44-turn coil extends the lower frequency to 6845 kHz. It is possible to cover 40, 20, and 15 meters with this coil by tapping it to short more and more turns, but this compromises efficiency. A significant improvement in efficiency results from using shorter, unshorted coils to cover additional bands.

20 Meters

See Figure 4. The 20 meter resonator is constructed from a coil form made from a 1.5" PVC coupling sleeve and 1.5" PVC pipe cap. The cap and sleeve are connected with a short length of 1.5" PVC pipe and PVC cement. Cap and sleeve are pressed together for a zero clearance fit. Thirteen turns of coaxial cable is then close-wound onto this form and secured with epoxy. Almost any smaller diameter coax such as RG59, RG58, or RG62 can be used here. RG223 may offer superior performance with its silver-plated double shielding. Only the shield is used. Cut the center conductor flush at each end of the coil. A bolt is installed in the center of the pipe cap for the whip. This same bolt is used to secure the 5"-diameter brass disk that serves as a top hat. The top hat is required to bring this resonator down to the 20 meter band because the coil does not provide enough inductance to do the job alone. An additional three turns on the coil would eliminate the top hat, but I had better results using the top hat. The top hat also provides a convenient connection for the upper termination of the coil. The coax braid is passed through a hole in the disk and soldered.

Tuning

After the mast is mounted to the vehicle and the feedline has been routed and connected you are ready to tune the resonators. A grid dip meter is useful but not necessary. Start with the 75 meter resonator. With the transceiver tuned to 75 meters, adjust the taps on the resonator while listening for an increase in noise from the rig. There should be a dramatic increase in noise as you approach resonance. I experienced a difference of four S-units between resonant and non-resonant conditions. You will probably have to tune the rig across the band while experimenting with the taps to find the noise peak. When you have the resonator peaked for noise, use an SWR bridge to find the best tap on the matching coil for a 50-ohm match. I found my optimum match with five turns of matching coil shorted to ground. With 100 watts and the SWR meter set to maximum sensitivity, there was only a slight indication of movement from the meter pointer indicating an insignificant amount of reflected power. Experiments with a pencil drew 1/4"-long arcs of RF from the ends of the capacity hat under these conditions, indicating that power was indeed being transferred to the antenna.

A #47 pilot light bulb or equivalent can also be used to indicate current flow in the antenna. Attach test leads to the bulb. Connect one test lead to the ground connection at the base of the antenna. Connect the other test lead to the lower end of the resonator coil. Key down and *carefully* increase power output while on frequency at a suspected resonance point. There will be a significant increase in brightness as the transceiver is tuned through the resonance point. The test leads can be of equal length as actual location of the bulb is not critical. Total length of the test leads should approximate the distance between the electrical connections of the indicator to the mast to keep the slack in the wire to a minimum.

There are three logical ways to shift the resonance point. Moving the taps on the coil will cause the greatest shift. Adjusting the length of the whip in small increments will cause the smallest shift. Increasing the length or number of radial wires of the capacity hat will shift the point down in frequency; decreasing them will cause an upward shift. With so many ways of tuning it is possible to bring the resonance point very precisely to any frequency in the band. Once you determine the various points of resonance for each coil tap, you may want to make a chart for future reference. As long as the installation is not modified the results are consistently reproducible. A chart would allow frequency changes without the need for an SWR meter.

Tuning becomes less critical as frequency and bandwidth increase. Once you have the antenna working properly on 75 meters, additional adjustments to whip length become undesirable. Any further adjustments to the whip length to fine-tune the other bands will detune the system for the 75 meter resonator. Alternate means of tuning become desirable. On 40 meters, coil tapping is the simplest solution. If coil tapping is not desirable for whatever reason (i.e. inconvenient location on the coil), the addition of a small capacity hat will help fine-tune the system. The strategy here is to end up with a fixed whip length optimized for the lower frequency band. Resonance on the other bands becomes a function of resonator characteristics alone, allowing quick and easy band changes while preserving efficiency. Where used, all the top hats are an integral part of the resonator assemblies.

The input impedance of the system does change from band to band, but a low SWR can still be maintained with the 75 meter matching coil tap. The convenience of a permanent connection on the matching coil for all bands outweighs the minor decrease in efficiency resulting from a 0.5 change in SWR. I found no change in performance between an SWR of 1:1 and an SWR of 1.5:1. In fact, the only downside to running a 3:1 SWR is decreased power output from my solid-state transceiver. I can still communicate effectively at the higher SWR. Feedline losses appear to be near insignificant with a feedline length of only 15 feet and the antenna still radiates the power it receives.

After all the resonators were built, tuned and tested over a period of several weeks, I encapsulated them with polyester Fiberglas resin. This is a smelly, messy process but very effectively seals the coils. No shift in frequency or performance was observed after encapsulation. After the resin cured, I spray-painted all parts of the antenna flat black to improve the appearance of the installation. Take care to ensure that the paint is non-conductive. A flashy metal flake paint job will ensure a disaster instead of the inexpensive and effective HF mobile antenna system desired.

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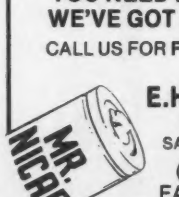

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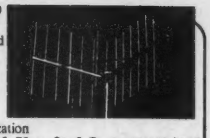

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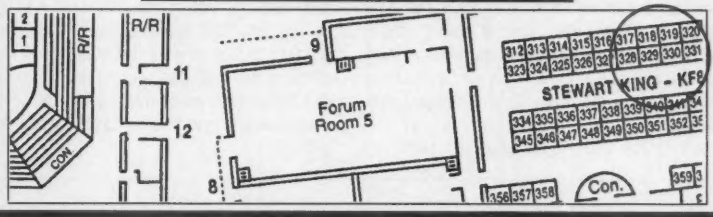

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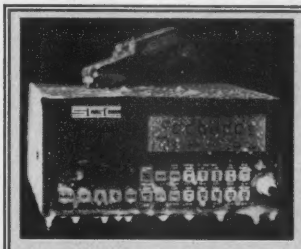

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CIRCLE 384 ON READER SERVICE CARD

A Shortwave Converter for your Scanner

Build this easy gadget and listen in on HF.

by Steve Donnell WA1KYL

There are many ways of using a converter as a simple method for receiving HF broadcasts. Typically, the shortwaves (3-30 MHz) are converted down to the 540-1600 kHz band where a standard AM broadcast band receiver is used as a fixed or tunable IF. And while this conversion scheme can be considered cost effective, it is not without its problems. Things like limited tuning range, "feed-through" interference from local AM signals, the difficulty of accurate calibration, and even tuning images, can plague this classic design.

While the old AM Broadcast receiver hasn't completely disappeared from the scene, I chose to take a different approach by using a type of receiver that is becoming more and more common in homes and ham shacks, the VHF/UHF scanner. While scanners are typically used to receive FM modulated signals, many can also receive the VHF aircraft band (118-136 MHz AM), perfect as the "IF" for a shortwave converter. And as many newer designs for 2 meter transceivers can also receive AM signals in this range, the use of this band as an IF for a shortwave converter becomes even more logical.

Design

For the sake of simplicity, I designed my HF-to-VHF converter around the NE-602 IC (see Figure 1). The NE-602 IC is very popular with experimenters because of its ability to frequency-convert RF signals across a wide range of frequencies. Internally, the NE-602 consists of an oscillator that can be configured in a number of ways as an L/C or a crystal-tuned design. The oscillator feeds into an active mixer, which can accommodate signals of up to 100 MHz in frequency. Since most of the applications I have seen for the NE-602 were for RF conversions be-

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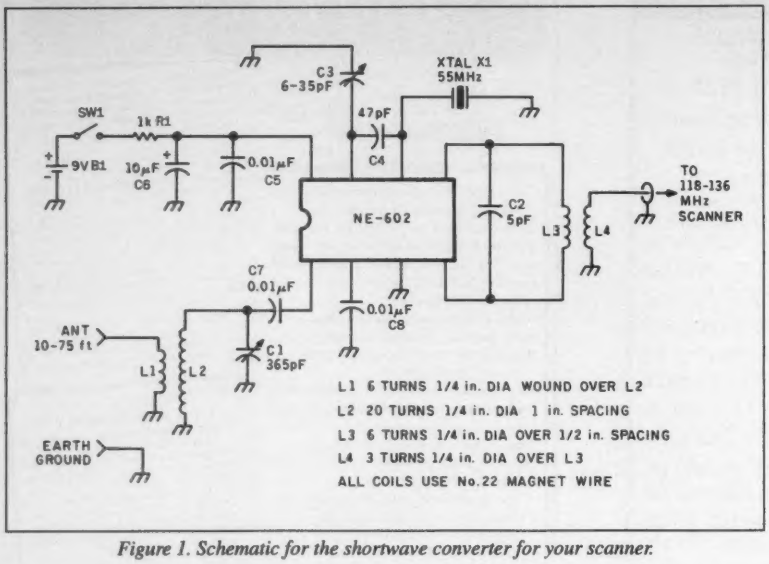

Figure 1. Schematic for the shortwave converter for your scanner.

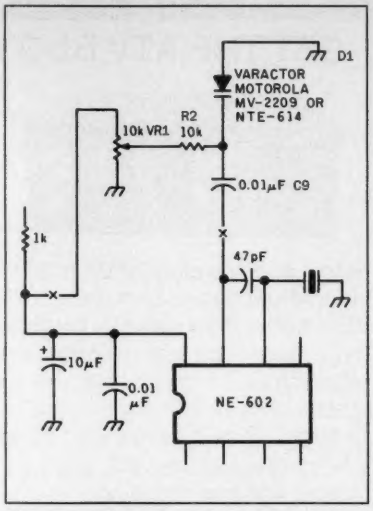

Figure 2. Schematic variation using a crystal tuning circuit with a varactor.

low 50 MHz, I wondered if I might be taxing the limits of the IC a bit at these higher VHF frequencies. But I soon discovered that these concerns were unwarranted.

RF signals from a receiving antenna are coupled into the converter by way of L1, and then to L2. L2 and C1, a 365 pF variable capacitor, function as a tuned "preselecter" to filter out noise and interference outside of the specific frequency band you want to receive. L1 and L2 are made with common #22 magnet wire, wound on a 1/4"-diameter plastic or wooden coil form. L1 is wound directly over L2. The desired receive frequencies are then coupled into the mixer of the NE-602 at pin 1.

For best stability and easiest calibration, I used a crystal oscillator design for the converter. Although somewhat better results might have been achieved using a crystal with an overtone frequency in the 110 MHz area, crystals in this range are not commonly found in the junk boxes of many experi-

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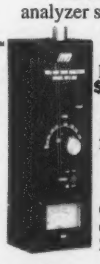

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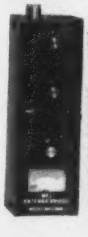

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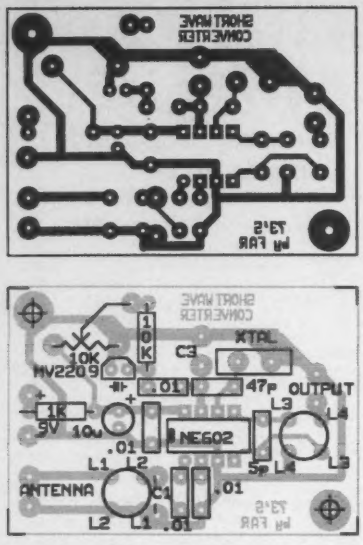

Figure 3. PCB layout and parts placement diagram.

Parts List

B1	9-volt battery
U1	NE-602 IC
D1	MV-2209 or NTE-614 varactor
L1	6 turns of #22 magnet wire wound over L2
L2	20 turns of #22 magnet wire 0.250" dia. 1" in length
L3	6 turns of #22 magnet wire 0.250" dia. 0.500" in length
L4	3 turns of #22 magnet wire wound over L3
C1	9.6-365 pF variable capacitor
C2	5 pF cpapcitor
C3	5-35 pF trimmer capacitor
C4	47 pF capacitor
C5	0.01 µF capacitor
C6	10 µF electrolytic capacitor
C7	0.01 µF capacitor
C8	0.01 µF capacitor
C9	0.01 µF capacitor
R1	1k ohm resistor
R2	10k ohm resistor
S1	SPST switch
VR1	10k ohm potentiometer

menters and may have been too close to the edge of the NE-602's oscillator to operate reliably. Thus, I chose to use an oscillator operating in the 50 MHz range. Crystals in this frequency range are commonly found in the junk boxes of most VHF circuit experimenters. I also figured that anyone with a programmable scanner might also have a couple of old VHF low-band scanner crystals around that could use a second life. Depending on what frequency range you want to receive, any old scanner crystal meant for receiving VHF channels in the 39-46 MHz range can be used. A scanner crystal used for receiving 45.30 MHz would actually have an oscillation frequency of 56.00 or 56.10 MHz (45.30 + 10.7 or 10.8 MHz), depending on what kind of scanner it was made to be used in, 10.7 and 10.8 MHz being the IF offset for the two most common varieties of scanners.

The best choice for a crystal would be one used to receive a frequency of 44.30 MHz in a scanner with a 10.7 MHz first IF. The crystal would actually be operating at 55 MHz (44.3 + 10.7 MHz). The second harmonic of the 55 MHz oscillation (110 MHz), provides the necessary local oscillator signal to convert the desired shortwave signals up to the 118-136 MHz band. The process of "upconverting" to a first IF that is a higher frequency than the original is not that unique. Receiver designs common to many HF receiver/transceivers currently on the market use a 70 MHz first IF.

A small-value trimmer or variable capacitor, C3, is needed to act as a "fine-tuning" control for the converter. Not only is this used for initial calibration, but it will also help in peak tuning of HF signals (some scanners use only 10 kHz tuning increments across the aircraft band, although most tune in 5 kHz increments). If the converter is housed in an enclosure of some kind you will want to mount C3 so it can be externally adjusted. If a chassis-mountable variable capacitor is not available for C3, a different approach would be to use a crystal tuning circuit with a varactor (see Figure 2), although this adds somewhat to the complexity of the circuit. I have often found that varactors can be more easily obtained from parts suppliers and off junk PC boards than mechanical capacitors. Depending on the varactor used, you may also need to add an extra 10 to 30 pF of fixed capacitance across it. By using the varactor, a common 10k potentiometer will become the fine-tuning control.

The mixer output is from pins 4 and 5 of the NE-602. Capacitor C2 and coil L3 function as a filter peak tuned in the middle of the aircraft band (approximately 128 MHz) and couple the desired converter signals into coil L4. L3 and L4 are wound from a short piece of #22 magnet wire, on a wooden or plastic coil form. L4 is wound directly over L3. Be sure that no direct DC "short" exists between L3 and L4. Because of the limited number of turns in L3 and L4, after the coils were wound and mounted to the circuit board I was able to remove the plastic dowel I used as the coil form for L3 and L4, and reuse it for winding L1 and L2 on. Connection of the converter to the scanner is made through a short length of coax cable, from the ground and L4 connection of the converter to the normal antenna connection of the scanner or other aircraft band receiver that is to be used as the converter's IF.

Construction and Alignment

There is nothing too critical about the parts layout and fabrication method for the converter circuit. In the construction of the prototype for this circuit I used an etched copper-clad board. But I mounted the parts directly to the copper side, without needing to drill through the board. I refer to this method as "pseudo-surface mount." An easier method would be to mail away for the prefabricated PC board. A drilled and etched PC board is available for $4 plus $1.50 S & H per order from Far Circuits, 18N640 Field Court, Dundee, IL 60118.

Alignment of the converter is easy. After verifying that the crystal oscillator was operating by listening for the fundamental or second harmonic with a monitor receiver, I then netted the frequency of the crystal on so as to produce as close as possible an integer value for its second harmonic frequency. This makes for the simplest conversion calculation from the HF frequency that you want to receive, and what you need to program into your scanner to hear it.

I then connected a longwire antenna to the input of the converter and connected the output to a portable scanner, to which I programmed in a frequency that was 10 MHz above the converter's local oscillator frequency. Capacitor C1 was adjusted to the clearest signal from the 10 MHz carrier of WWV. The converter's output circuit was peak-tuned by merely adjusting the spacing in the wire turns coil L3.

Although the measured sensitivity of the converter is at best about 3 µV, I have been able to easily receive stations like WWV and the BBC using the converter into my PRO-34 scanner, with little more than a two-foot-long test cable as my "antenna." A 20-to-75-foot-long wire or a tuned dipole will achieve better results.

I have not tried this, but a somewhat "deluxe" approach to housing this converter would be to mount it inside any one of the many shortwave antenna tuner/preselecters available commercially. This would eliminate the need to use the L1, L2 and C1 filter portion of the converter. This would also be likely to work better than the original filter. An even better approach would be to use a commercial tuner/preselecter that also includes a signal preamp. This would provide an active stage of amplification ahead of the converter's input for even better receive sensitivity.

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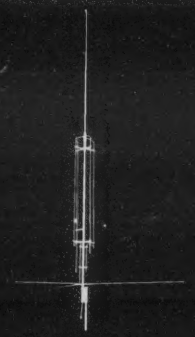

Eagle DX

Challenger DX

Voyager DX

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Worldradio – "These guys have solved the problem associated with verticals. That is, an awful lot of RF is wallowing around and dropping into the dirt instead of going outward bound. A half-wave vertical does need radials if it is end fed (at the bottom). But the same half-wave vertical does not (as much, hardly at all) if is fed in the center."

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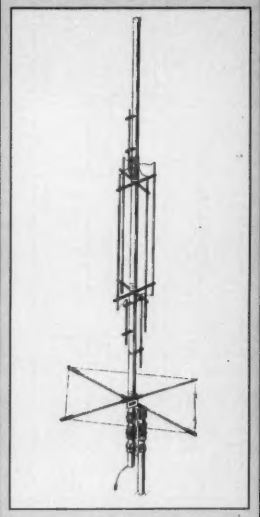
New Release: TITAN DX



This all purpose antenna is designed to operate 10m-80m, WARC bands included. It sits on a 1-1/4" pipe and can be mounted close to the ground or up on a roof. Its bandwidth and no tune feature make it an ideal antenna for the limited space environment as well as a terrific addition to the antenna farm.

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Frequency Selective Filters for UHF and Up

A filter is a device or circuit that selectively discriminates against some frequencies, while favoring other frequencies. The cluster of favored frequencies is called the *passband* while the rejected frequencies are called the *stopband*. The filter operates by providing a large attenuation for stopband frequencies, and a minimum attenuation (ideally zero) for passband frequencies.

There are four general classes of filter that we will consider here: *low-pass, high-pass, bandpass and bandstop*.

The low-pass filter (LPF) characteristic (Figure 1A) shows that the filter passes frequencies from DC or near-DC to some *cut-off frequency* (F_C). The attenuation increases above the cut-off frequency until the maximum stopband value is reached. The filter *skirt* is the transition region between the passband and full stopband. The steepness of the skirt slope defines the filter quality.

The skirt slope is usually specified in terms of decibels of attenuation per octave (2:1 frequency change) or per decade (10:1 frequency change), i.e. dB/octave or dB/decade. If, for example, a low-pass filter is specified to exhibit a 10 dB/octave slope for a 200 MHz cut-off frequency, the attenuation at 400 MHz is 10 dB greater than the attenuation at 200 MHz, and at 800 MHz it is 20 dB greater than the 200 MHz value.

The cut-off frequency is defined as the frequency at which the response falls off -3 dB from its passband response. Because the passband response isn't smooth, however, the average attenuation value is used, and the cut-off frequency is found at the point where the attenuation figure increases three decibels (see "3 dB" point in Figure 1A).

The high-pass filter (HPF) has a response curve that is the inverse "mirror image" of the LPF response (see Figure 1B). The attenuation is very high below the cut-off frequency, and minimum above the cut-off frequency. As was true in the LPF case, the HPF has a skirt or transition region between the stopband and the passband.

The bandpass filter (BPF) is a combination of the LPF and HPF responses in which the respective cut-off frequencies are different (see Figure 1C). In the BPF there is a high attenuation stopband above and below the minimum attenuation passband region.

The passband bandwidth is defined as the frequency difference between the upper cut-off frequency (F_H) and lower cut-off frequency (F_L) on the response curve (F_H - F_L in Figure 1C). This expression of bandwidth is usually called the "3-dB bandwidth" and is often abbreviated in data sheets and specifications as "BW3-dB."

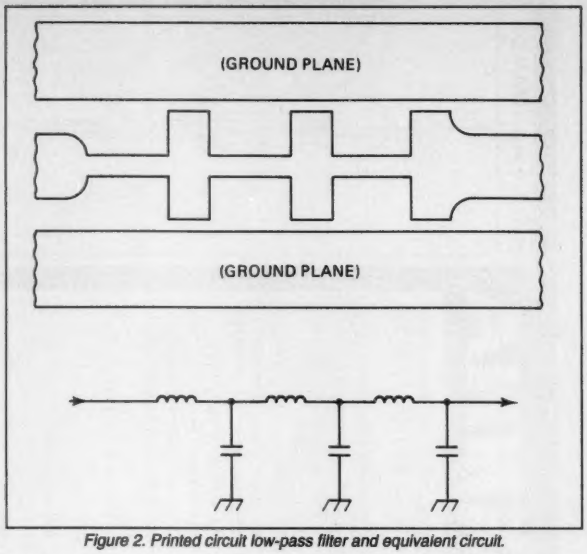

Figure 2. Printed circuit low-pass filter and equivalent circuit.

The upper and lower skirts define the sharpness of the cut-off characteristic between the passband and the two stopbands. This parameter is defined by the *shape factor*, which is the ratio of the 60 dB bandwidth to the 3-dB bandwidth. In terms of Figure 1C, the shape factor (SF) is:

$$S.F. = \frac{F_2 - F_1}{F_H - F_L} \quad (1)$$

or,

$$S.F. = \frac{BW_{60\ dB}}{BW_{3\ dB}} \quad (2)$$

The *figure of merit* or *quality factor* ("Q") of a bandpass filter is defined as the ratio of center frequency to the 3-dB bandwidth:

$$Q = \frac{F_C}{BW_{3\ dB}} \quad (3)$$

The Q and the shape factor must be considered in selecting or designing microwave filter circuits. The most obvious factor is the relative position of other-frequency signals compared with the center frequency of the filter. Also, the bandwidth must be sufficient to properly pass the spectrum of the expected signals without also being so wide that other signals and excess noise signals are also admitted. For fast rise-time signals (such as pulses or digital signals), a filter that is too narrow (i.e. too high Q) will "ring" in the same manner as in LC resonant "tank" circuits.

The passband of an ideal filter is perfectly "flat" (i.e. constant attenuation) for all frequencies between the cut-off frequencies. But in real filters this ideal condition is never met, so a certain *ripple factor* (see Figure 1C) exists within the passband. In high quality filters the passband ripple will be on the order of 0.1 dB to 0.5 dB, although in some cases a larger ripple (e.g. 1 dB) factor will be acceptable.

The *insertion loss* of a filter is the attenuation of signals inside the passband. Ideally, the insertion loss is zero, but that is not achievable. In most designs, the better the shape factor, or the higher the Q, the worse the insertion loss. This phenomenon is due to the fact that such filters usually have more elements or "poles" than lesser types, so therefore show greater in-band loss. Many circuit designers opt for a pre-filter or post-filter amplifier to make up for insertion loss.

The bandstop filter (BSP) is the inverse of the bandpass filter. The attenuation is greatest between the cut-off frequencies (see Figure 1D). At frequencies above and below the stopband signals are passed with minimal "insertion loss" attenuation. The purpose of a

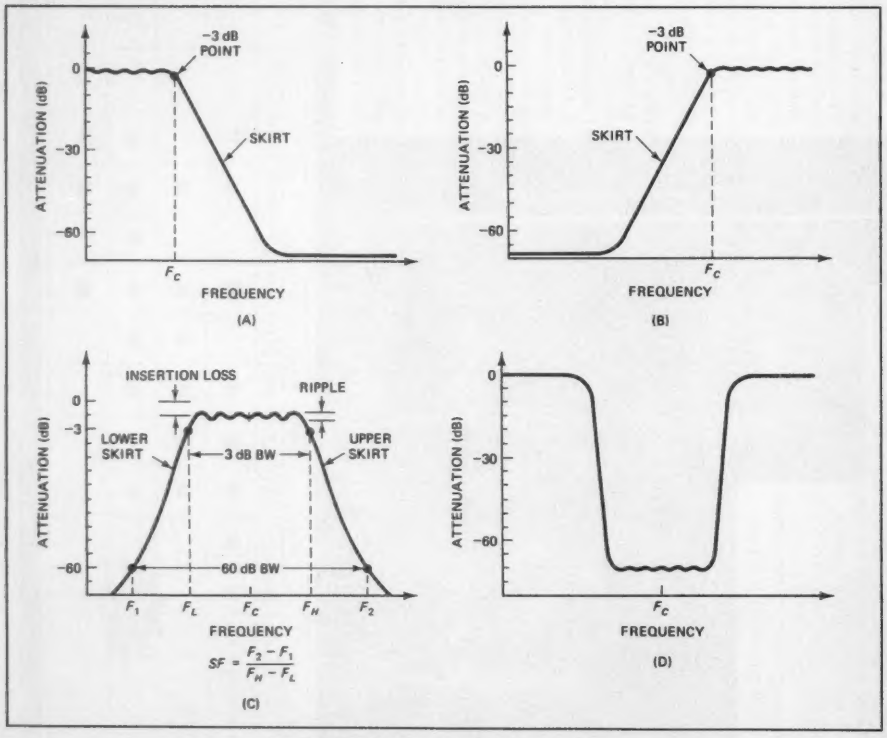

Figure 1. Filter frequency response characteristics.

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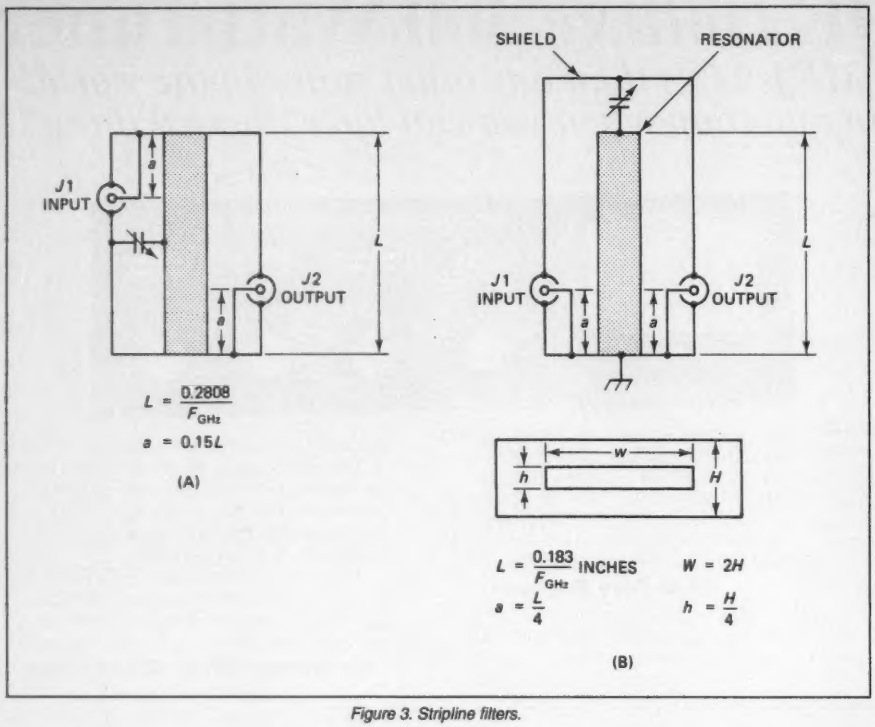


Figure 3. Stripline filters.

bandstop filter is to remove offending signals. An example is in communications systems where transmitters and receivers on two different frequencies are co-located at the same site. A receiver on frequency F1 will have a front-end bandstop filter on frequency F2, i.e. on the frequency of the co-located transmitter.

Typical UHF/Microwave Filters

At frequencies lower than microwave bands filters are often designed using lumped inductance and capacitance (L and C) components. In the microwave bands implementation of filters is through printed circuit stripline or (in UHF and low microwave bands) chip components. Figure 2 shows a microwave stripline implementation of a low-pass filter (HPF, BPF and BSP designs use the same methods but with different layouts).

As microwave frequencies increase the dimensions of the stripline components get smaller, eventually becoming too small to either carry required load currents or to be easily built using ordinary printed circuit techniques. But stripline width is a function of system impedance as well as frequency. As a result, microwave filter designers often design a filter for a lower input and/or output impedance than is required by the system, and then provide impedance matching networks to renormalize the circuit. For example, in a 50-ohm system the filter may be designed for 20-ohm termination impedances, with a 50:20-ohm impedance transformation provided at the input and output terminals. The resultant filter will have wider (more easily built) stripline tracks.

Two forms of resonant stripline bandpass filter are shown in Figure 3. The half-wavelength version is shown in Figure 3A, and the quarter-wavelength version in Figure 3B. This is a form of transmission line filter, and is usually built inside of a shielded container. At one time, one would cut metal strips (see older editions of *The ARRL Radio Amateur's Handbook* for examples) for the resonator (shaded area), but today an appropriate section of printed circuit board stripline can be substituted.

Another form of stripline filter is the interdigial design shown in Figure 4. This type of filter consists of a series of quarter-wavelength stripline transmission line segments. This sort of filter can be used well into the microwave region and are well suited to MMIC and hybrid circuit designs.

Figure 5 shows several forms of waveguide frequency selective filters. The cut-off frequency of waveguide is a function of crossectional dimensions. Similarly, inductive and capactive circuit action is found through the use of restrictive "irises" in a segment of waveguide. In Figure 5A we see the stepped or staircase bandpass filter. In this design, critically dimensioned steps are machined into the internal surfaces of a section of waveguide.

A cavity-type series resonant bandpass filter is shown in Figure 3B. Using a re-entrant resonant cavity, this filter allows passage of signals with a frequency around the resonant frequency. A parallel resonant cavity bandpass filter is shown in Figure 3C. This particular version is tunable by virtue of the volume-changing tuning disk inside of the cavity.

Conclusion

Filter circuits for VHF, UHF and our lower microwave bands need not be too complex to be effective. In some cases, filter elements can be purchased. Digi-Key (POB 677, Thief River Falls, MN) sells Toko helical resonators for VHF/UHF bands. Also, the advertisers in this magazine are sources of some forms of filter elements and parts. Finally, you can build them yourself.

I can be contacted at P.O. Box 1099, Falls Church, VA.

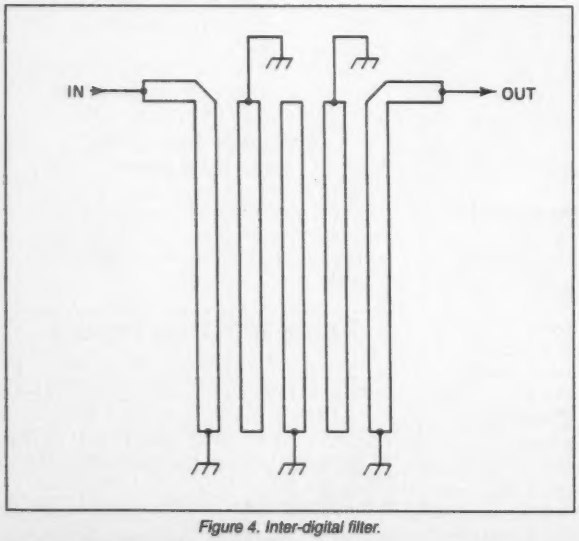


Figure 4. Inter-digital filter.

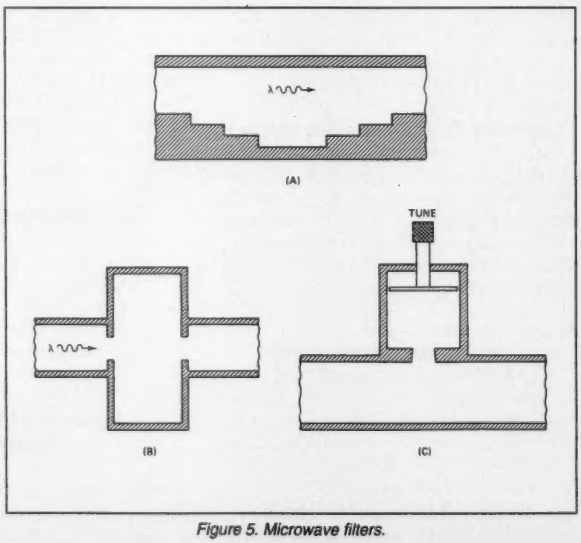
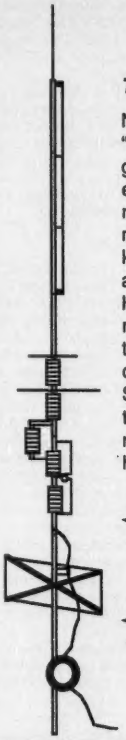


Figure 5. Microwave filters.



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More from the E-mail Bag

If nothing else, many of you have been keeping my online mailbox full with E-mail on the various services on a regular basis. Let's keep looking at what tickles your fancy.

Success with HamComm Software

Luis Orozco N5UHB, tells us, via Internet, that he is 17 years old and about to start his last semester in high school. He lived in Las Cruces, New Mexico, from 1991-1994, and is now living in Monterrey, Mexico. He hopes to get his Mexican ham license soon, having been born in Mexico, living in Monterrey most of his life.

He passes along the following comments, from an admitted beginner in RTTY:

"I first started in RTTY when I got ahold of an early version of HamComm. I gathered the parts and built the little op amp interface for it, and I hooked it up to my HF rig to see what happened. Well, to my surprise, there I was, copying RTTY, and best of all, I hadn't spent a penny! I never got around to building any interface for transmitting, so I just listened for a long time. A few months ago, I was listening to a QSO, and I really wanted to join in, but didn't have any way to do it. Well, since HamComm will generate the RTTY tone in the PC speaker, I just put the rig on sideband and keyed the microphone, and made the PC send a 'de N5UHB N5UHB N5UHB k.' It worked, and one of the other stations came back to me. It was a good QSO. I'm not on the air right now, but as soon as I get into HF again I'll have to hook up the PC-speaker audio to the microphone audio input through a transformer. By the way, later I got the new version of HamComm, which also works in AMTOR. In my opinion, HamComm is one of the few shareware programs that's worth the 'registration fee' (even if you gotta send it all the way to Europe!).

That's about it. I just thought you'd like to know N5UHB's way to get into RTTY for the least amount of cash. I'm sure there are lots of people out there who can't afford a modem or multimode controller but would still like to play RTTY."

Luis, I appreciate your observations, as one of the most common questions I get is a request for a suggestion for starting software. Of course, HamComm is one of the featured programs in the RTTY Loop Software series. Version 2.2 of the program is on Disk #5, and any updates received will be included on future disks as well.

RTTY for the Mac

Another E-mail correspondent is Paulo Teixeira N3MGA, who is responding to the quest of Ralph Howard WD6BGN for an interfaceless RTTY program for a Macintosh computer:

"Bad news, such a thing does not exist as of yet. I would recommend that he, at this point, get Hostmaster for his KAM, which is available directly from Kantronics. That program supports RTTY as well as other digital modes for HF and VHF.

As soon as I got my first Mac and a modem, I hit the major online services searching for software that would help me with the hobby, namely with packet. Not much was found, except for an excellent effort at AOL on their Ham Radio/Mac section. I downloaded most of what I found and over time I got a good collection of files. My next step was the Internet, where I gathered more programs and met some of the developers.

Nowadays, I have decided to share my findings through a small one-line BBS I run from home, which is on 24 hours a day and is available free of charge to anyone. The name is Gallery's BBS and it's at (202) 333-0407. Files sections consist mainly of Ham radio shareware for the Mac and other general files for that platform. I normally scan between two to four Internet FTP sites on a weekly basis in search of the latest software, which pretty much sums up that if my BBS doesn't have it, it is not available.

I hope this information can help some of your readers and, again, anyone is welcome to log on and download whatever they like."

Well, Paulo, since I do not have a Mac, it has seemed rather clumsy for me to offer Mac software, which is, as you note, available at various places online, as part of the PC-based "RTTY Loop" collection. I therefore welcome your support for the Mac. If my guess is correct, readers of this column should be patient, the busy signal on your BBS should be a constant finding for a while.

Using the CoCo for RTTY

Since we've heard from a PC user and a Mac user, it seems only fair to give the user of another system his day in the sun. Stephen Coker VA3LS, tells us of his operations with the Yaesu YR-901 CW/RTTY Code Reader and the YK-901 keyboard for RTTY. He normally uses it on HF, but did try 2 meter RTTY once and worked direct over 80 miles with only 20 watts! Computerwise, he has a Radio Shack CoCo3 color computer, as well as an IBM in the shack. He hopes to try the CoCo out on RTTY, if he can find software for it.

Well, Stephen, if you will look around, there are a few programs online for the CoCo. One site available to Internet users is the CoCo SIG on Delphi. You can either telnet to Delphi, or take advantage of the bargain rates detailed here a few months ago to join the net directly. Good luck, and let me hear how you are making out.

"RTTY Loop" Software

In the comments on HamComm, I referred to the "RTTY Loop" Software Series. For those of you who may have come in late, and Wayne tells me that there are lots of new subscribers, I have eight collections of programs, mostly PC compatible, of use to RTTY/packet hams. Disk #3 is unique, as it is a collection of DOS/Windows utilities for archiving and viewing programs. The others are various RTTY, packet, AMTOR, CW, and utility programs. Send me a self-addressed, stamped envelope, to the above address, or E-mail to me on CompuServe (75036,2501), Delphi (MarcWA3AJR), America Online (MarcWA3AJR), or use the AOL Internet access at MarcWA3AJR@aol.com, and I will be happy to send you a copy of the list. The programs may be yours by sending me sufficient media, a stamped return disk mailer, and $2 per disk to be filled, to the above address.

More than requests for the disks, though, I look forward to your comments, questions, and suggestions. In the pipeline is a review of an inexpensive way to get onto VHF packet, and maybe a look at some other equipment as well. While things are still fluid at this time, I look forward to other exciting developments in the coming months' "RTTY Loop."

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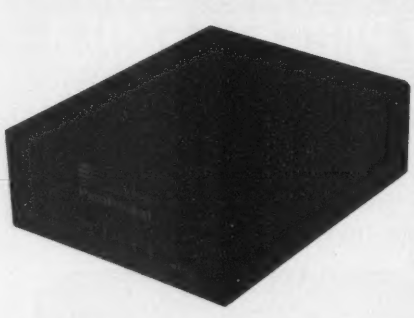

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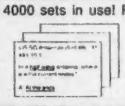

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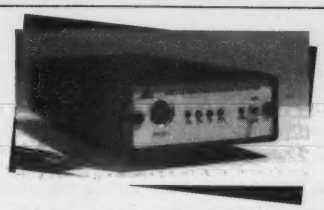

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The Dragon Slayer

All right. I'll admit it. There are times when the dragon wins, even when running QRP. So, what do you do? Well, I could run over to Randy KD8JN's QTH and fire up Mr. Heath SB220, then dump the output of his Argonaut II into the amp and really chase the DX. However, Randy is usually busy trying to talk his wife into letting him go to the next hamfest. I really don't want to get involved with that program.

So, I did the next best thing—I designed my own dragon slayer QRP amplifier. That sounds like a double standard to me! But since this is April, what better time to get one more project under your belt?

The circuit is really simple. This amplifier will produce over 1 kW at keydown with less than 1 watt of drive. Since I work 40 meter CW most of the time, there is no band switch to mess with. You can put the amplifier on any band you wish by changing out the filter components used in the output filter. Since we are working with more power than most of us are used to, the output filter may be a hard part to reproduce. Follow the details in the schematic for the filter. I used 3/4" copper pipe filled with an inert gas. Don't use helium, though—it causes the CW note to sound like a Tweety bird in a blender. Nitrogen is the preferred gas for the filter.

Drive from the exciter is fed into the base of Q1 via the matching transformer. This provides a 50-ohm load for the driver and matches the low impedance of the base of the transistor. This amplifier uses four transistors, one for every 10 meters of wavelength. Thus, an amplifier designed for 40 meters will require four output transistors.

The transistor I decided on is the very popular 2N2222a. However, be sure you use the metal case device and not the TO-92 plastic style. I'll explain why later on.

I don't operate SSB, so the amplifier is biased for class RCS operation. Thus, no current flows until drive is applied to the amplifier. If you want, a small bias voltage could be placed on the base of each output transistor, but keep in mind you'll need to balance the collector current of each transistor. A 105 amp/hour car battery would be an ideal bias supply.

Instead of using a special regulator just for the amplifier's bias, we can employ an old trick. The forward voltage drop across an LED will provide a very stable 1.5 volts. However, that's not going to be enough bias for good class RAS operation, so instead of an LED we'll use a Dark Emitting Diode or DED. A DED will supply 5.6 volts when forward biased. A 48-ohm 250-watt carbon resistor should be used to limit current through the DED.

To generate a full kW of output means we have to supply our amplifier with lots of input power. For shack use, a Lincoln RM-63 welder is ideal. Be sure you operate the Lincoln on a 220-volt AC buss. If possible, use a 440-volt AC input to keep the line voltage from dropping during keydown.

Not to leave us QRPers out in left field during Field Day, you can also use a Miller Blue Star 2E portable welder/generator. I like the Miller unit because it has an auto idle feature to slow the engine down during standby.

In either case, feeding all this power to the amplifier requires a bit more care than usual. I prefer to use fourought weld cable. It's flexible and easy to route from the power source to the amplifier. I should have used fuses in the DC lead, but the voltage drop caused me lots of headaches. So, I depend on the power company's main breaker at the pole in case of trouble.

Nothing in life is perfect and this amplifier is no exception to the rule. The amplifier is about 60 percent efficient. The rest of the energy is turned into heat—heat that must be removed. I worked on a water-cooled system, but tossed it out as being too complex. I went for a forced-air cooling system. Be advised: The forced air cooling may not be enough to keep the amplifier from melting if you bias the amp for class RAS operation.

The Heat Sinks

The heart of the cooling system lies in the one-foot-by-one-foot extruded aluminum heat sink. There's one heat sink for each transistor. Now you can see why I specified the metal case 2N2222 transistor. The metal case of the transistor is bonded to the aluminum heat sink by using "solder it" soldering compound. Each output transistor is mounted smack dab in the middle of each heat sink. Because the case of the transistor is internally connected to the collector, the heat sink also provides an excellent method of routing the DC operating voltage to the amplifier.

The downside of this idea? All four heat sinks are now hot with DC and RF. I used Teflon to insulate the heat sinks from the outside environment. Keep the kids, cat, dog and other untedar mammals away from the amplifier. An RF burn from this guy would be rather painful!

There are also eight 220-volt muffin fans attached to the heat sinks. One fan blows on one end and another sucks the air out. Thus, there are two fans for each heat sink. There are four heat sinks, for a total of eight fans. This "blow/suck" cooling seems to work quite well indeed. There is one slight drawback: With all those fans running, the noise level can be quite high. Ear protection would be a wise idea.

With the amplifier thus insulated, during keydown in a dark room the entire assembly takes on a hazy pink glow. As a side benefit, the amplifier now keeps the shack full of ozone. My shack has the fresh springtime thunderstorm smell! It's also a great way to light cigars!

Construction is simple. There's no PC board—the copper could not handle the current. Instead, I use 1/2" copper tubing pounded flat to wire the amplifier. You won't be able to use your standard soldering iron here. The copper tubing draws the heat away too fast to allow a good solder joint. So, I used a propane-powered torch. Building the amplifier used up about 20 pounds of propane. Keep the lead short and direct. Don't forget to bypass the welder at the input to the amplifier with 0.001 doorknob capacitors.

Putting the amplifier to work is easy. Just connect your antenna to the output RCA jack and connect your Argo up. Since this is a single-band amplifier, all you need to do is key down and start making contacts. Under normal operating conditions there will be some smoke as the weld cable heats up. This is normal.

I hope you enjoyed this project. It sure is a lot of fun to be on the top of the pile now and then. So, pick up some propane, a box of cigars and have fun. Projects like this only come once a year—*usually around the first of April.* 73

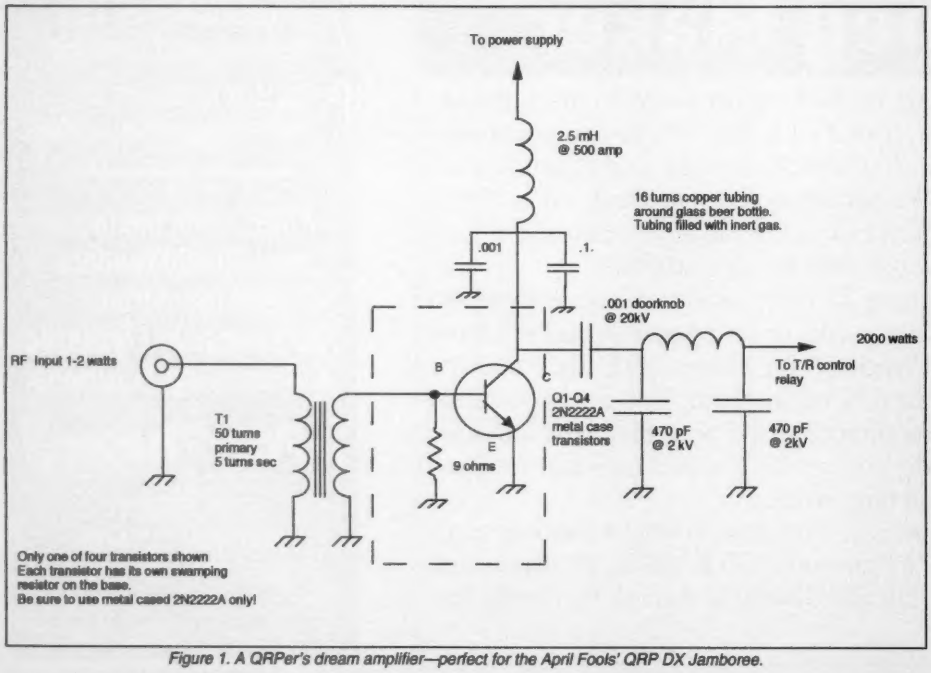

Figure 1. A QRPer's dream amplifier—perfect for the April Fools' QRP DX Jamboree.

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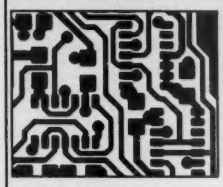

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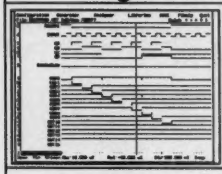

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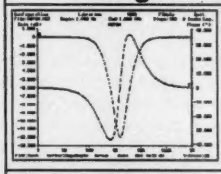

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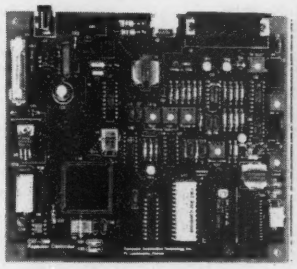

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Field Day Beam?

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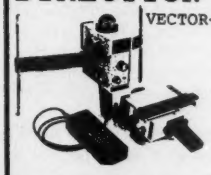

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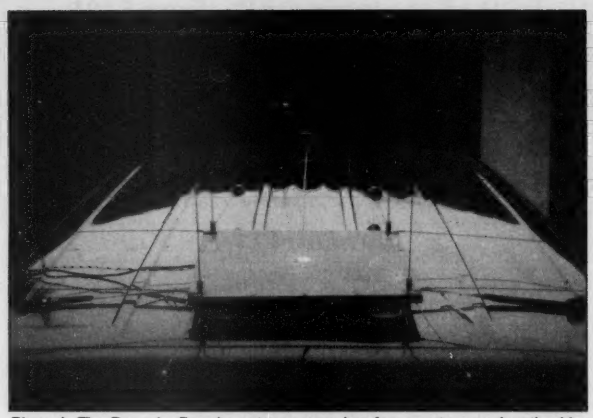

Photo A. The Roanoke Doppler antenna array has four quarter-wavelength whips on a 20 X 20 inch metal plate with eight radials to provide a ground plane under each whip.

A Good Doppler Gets Better

Chopsticks, silverware, plasticware, or your fingers? You can eat lunch with any of them. Your choice depends on where you are and what you're eating. Similarly, there are many methods for tracking a VHF signal, and more than one will work. Such factors as simplicity, cost, stealthiness, sensitivity, response time, and the nature of the signal come into play as you make your equipment decision.

Doppler units are the "weapons of choice" among radio direction finding (RDF) enthusiasts for mobile hidden transmitter hunting (sometimes called T-hunting or foxhunting) in many parts of the country. They indicate the direction of incoming VHF signals on a circular ring of light-emitting diodes or a digital display. A doppler set updates bearings almost instantaneously, so even short carrier bursts can be tracked.

A doppler installation can be done quickly on just about any vehicle. It has a much lower profile than an RDF yagi or quad setup. The multi-element antenna assembly replaces your mobile whip. The control unit extracts direction information from a tone that the antenna set adds to the audio output of your VHF-FM transceiver or scanner.

Excellent commercial doppler models are available for several hundred dollars, but you can build your own at a fraction of the cost. Today's most popular do-it-yourself doppler was originated by Chuck Tavaris N4FQ of Roanoke, Virginia. Tom Curlee WB6UZZ and I made some enhancements and documented the design. We named it the Roanoke Doppler in honor of N4FQ's T-hunting grounds.

Complete plans for the Roanoke Doppler are in *Transmitter Hunting—Radio Direction Finding Simplified* (TAB/McGraw-Hill #2701), available from Uncle Wayne's Bookshelf. One chapter in this book thoroughly discusses the theory of RDF using the doppler principle and gives much more information about techniques, advantages and disadvantages than space here allows.

Since publication, several hams have made circuit boards and kits available for the Roanoke Doppler controls and display. Presently, there are two board suppliers, listed in the sidebar. They are not affiliated with the book's authors or publisher, so contact them directly for information on their products.

Antenna Design Secrets

The doppler effect is created on an incoming signal by moving a vertical receiving antenna in a horizontal circle so rapidly that the signal's frequency appears to shift. Relative phase of the frequency-modulation tone produced by the doppler effect gives direction of arrival of the signal. For a useful FM deviation level of the doppler tone on typical VHF/UHF bands, the antenna must move at about 500 revolutions per second (30,000 RPM).

This rate is impractical mechanically (to say the least), so early doppler experimenters tried putting 16 or 32 vertical dipoles in a circle and connecting them one at a time to the receiver input at the 500 rotations per second rate. This would be just as difficult to achieve mechanically, but it can easily be done electrically with special RF positive-intrinsic-negative (PIN) diodes.

The first big "pseudo-rotating" arrays worked just fine, so experimenters tried to find out if fewer elements would work, too. They discovered that switched signals from four dipoles give the signal's direction data just fine if very narrow audio filtering (2 Hz or less bandwidth) is used in the tone processing circuits to recreate the sinusoidal doppler FM modulation of a single rotating dipole.

The Roanoke Doppler achieves this narrow bandwidth with a switched-capacitor bandpass filter. It is locked to the unit's master clock so that the filter's center frequency tracks the antenna rotation rate and thus the induced doppler tone. Experimenters also found that quarter-wavelength whips over a common ground plane make a good doppler array for mobile use.

There are some pitfalls to designing a multi-whip mobile doppler array. To simulate the effect of a single whip moving in a perfect circular track on the vehicle roof, each whip must be connected to the receiver for precisely one quarter of the total time and the switching sequence must be in the proper order of pseudo-rotation. The whip that is ON at a given instant must have low loss to the receiver input, while the three others must appear to be non-existent. As Tom and I discovered while optimizing the Roanoke Doppler array, OFF whips should not be electrically connected to the ground plane because that makes them parasitic elements that adversely affect the directivity of the ON whip.

You might think that each whip's directivity is not important because only phase information is being extracted from the doppler signal, not amplitude. But directional antennas, especially multi-element phased arrays, exhibit variations in phase output versus azimuth direction. It's a safe bet that the more amplitude directivity in an array, the more phase change versus direction it will have as well. Ideally, there should be no phase change versus signal direction for any single whip in the doppler array. Phase changes in the array output should be caused only by the pseudo-rotation.

To evaluate the effects that termina-

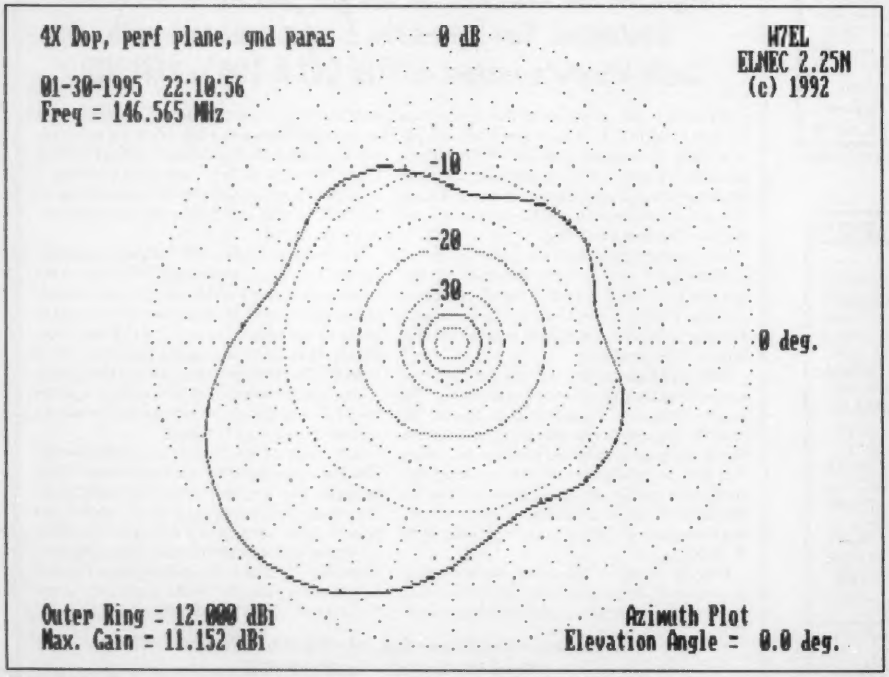

Figure 1. ELNEC azimuth pattern plot of a four-whip doppler array with three whips grounded and one connected to the feedline. The large lobe is in the direction of the active whip, which is in the lower left of the array.

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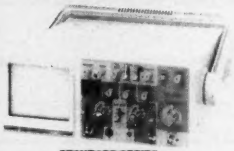

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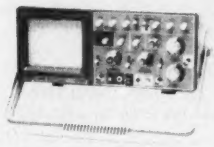

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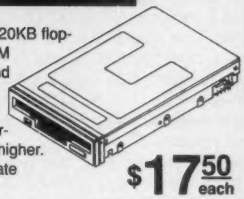

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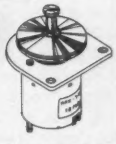

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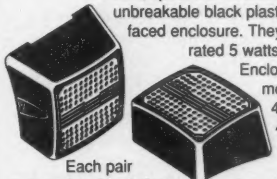

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tion of OFF whips can have on the active whip, I analyzed the Roanoke Doppler 2 meter array using ELNEC, an antenna modeling computer program for the PC. ELNEC produces azimuth and elevation radiation patterns for VHF and UHF single-element antennas, parasitic arrays, and phased arrays. For simplicity, I assumed four quarter-wavelength elements in an 18-inch square pattern over a perfect ground plane at an instant in time.

When OFF whips are grounded, the array is very directional, as Figure 1 shows. One whip in the clear would have 5.14 dB gain with respect to an isotropic radiator (dBi). Gain of this array varies from 11.15 dBi in the direction of the driven whip to 0.5 dBi in two other directions.

ELNEC does not plot phase versus azimuth. Creator Roy Lewallen W7EL told me that until I called him, no one had asked for this feature. Exact phase variation can be calculated, but the extra effort would not be worthwhile. The object of the analysis was to minimize the effect, not quantify it. It is clear that gain variation in excess of 10 dB produces an unacceptable amount of phase variation. On the other hand, if the OFF whip feedpoints are open-circuited (Figure 2), gain variation is only 1.1 dB, which is good.

Experience has proven the validity of this analysis. I have tested two four-whip doppler antenna designs (one commercial and one home-brew) that grounded the OFF whips with shunt PIN diodes at the antenna bases. In both cases, it was very difficult to get reliable bearings when the vehicle was moving on city streets. Performance improved markedly when the sets were modified to open-circuit the whip feedpoints when off.

The Roanoke Doppler antenna uses

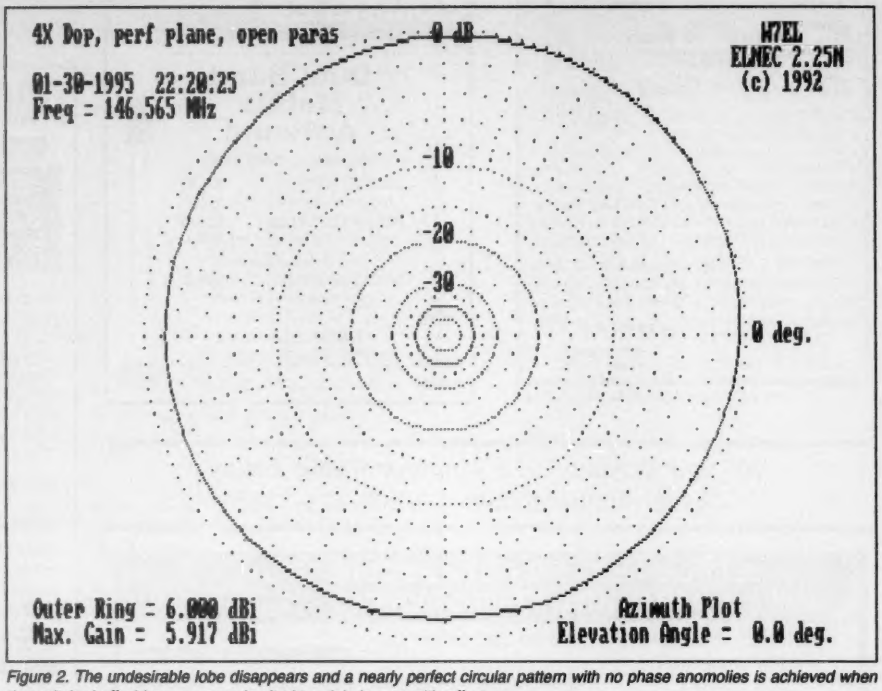

Figure 2. The undesirable lobe disappears and a nearly perfect circular pattern with no phase anomolies is achieved when the switched-off whips are open-circuited to minimize parasitic effects.

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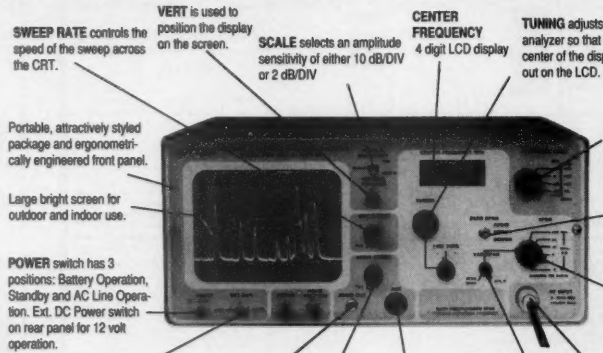
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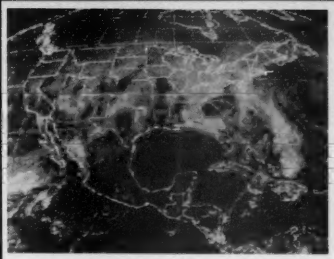

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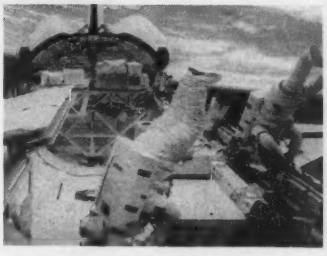

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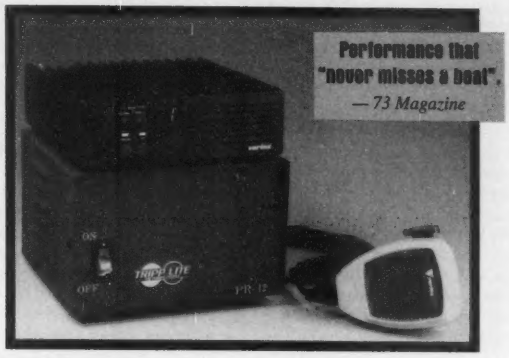

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PIN diodes to short the exact center of half-wavelength coax lines going from the common point to the feed point of each whip. Since an electrical quarter-wavelength of coax acts as an impedance transformer, an apparent open circuit exists at both the common point and feedpoint when the diode conducts.

Some RDFers have suggested that terminating OFF whips with 50 ohms would minimize reradiation and give the best pattern. However, ELNEC analysis showed that this is not the case. Gain variation would be almost 5 dB with loaded OFF whips, not nearly as good as open-circuiting them.

A New Roanoke Switcher

The Roanoke Doppler antenna design in the book works well on strong 2 meter signals. I have used it on over a hundred T-hunts. But it has room for improvement. The requirement for exact half-wavelengths of coax limits an array to a narrow frequency range (typically 5%). Furthermore, readers who have tried to scale the array for higher frequencies (such as the 70 centimeter band) have had disappointing results.

Last summer, I designed an improved switching system for the Roanoke Doppler and invited several T-hunters to build and test it. The new design (Figure 3) features series PIN diodes at each end of the coax lines to the four whips. This means that the coaxes can be any reasonable length, so long as the four lengths are equal. Coax lengths no longer limit the bandwidth of the array, so it is possible to use one array to cover tens of megahertz, limited only by array spacing and values of inductors and capacitors in the switcher. I have not tested the limits of its frequency range yet, but the new 2 meter array gives bearings on the 162.55 MHz weather station that are just as good as bearings on 146 MHz.

In the new Roanoke Doppler antenna switcher, PIN diodes receive more current drive in the ON state (7.5 mA), to reduce loss and improve overall sensitivity. Diodes are reverse-biased when OFF to provide better isolation. In my tests, the new switcher made the Roanoke Doppler noticeably more sensitive. It gives bearings on weak signals that would have been masked by switching noise with the original antenna.

It's not hard to upgrade your present Roanoke Doppler switcher to use the new circuit. Most of the existing chokes and capacitors are unaffected. Just delete half of each two-section RG-174 coax line, put PIN diodes at the end of each remaining line, add resistors at the antenna bases, then install L105 and C109. Note that the RG-174 lines to each whip are soldered to the plane at both ends, but the shield of the coax to the receiver connects to the plane through C109.

Changing from shunt to series RF diodes requires minor modifications in the control unit. The fifth wire in the control cable becomes a positive voltage source instead of a return connection. D13, D14, C26, and R38 set the potential on the counterpoise plane and radials at two diode drops below +5V (approximately +3.5V) instead of vehicle DC ground potential. If you fabricated the antenna unit per Photo A, using a copper-clad sheet on a wood base mounted with suction cups to insulate it from the car, DC on the sheet is not a problem.

I use Motorola MPN3401 PIN diodes at D101-D108. They are available by mail from Debco Electronics. Debco has no minimum order requirement. Your local parts house may carry the ECG-555 or NTE-555; both are good substitutes.

Miniature (quarter-watt resistor-sized) RF chokes typically have iron cores. The distributed capacitance of these chokes gives them self-resonant frequencies in the 75 MHz range. This is below 2 meters, so these chokes can act like capacitors instead of inductors there. Non-ferrous core chokes have self-resonant frequencies near 200 MHz, so be sure to use them in the switcher instead of iron-core chokes. For L101-L105, I recommend J. W. Miller #4602 (1.0 µH) or #4604 (1.5 µH), available at many local distributors. These chokes are about the size of a 1-watt resistor.

You can easily make your own 1 µH chokes on 1" lengths of 3/16" diameter polystyrene rods. Wind 24 turns of AWG 26 enameled wire on the rod in a single layer, close-spaced. With the wire held in place with a bit of tape, cover the winding lightly with Q-Dope, a liquid polystyrene coating made by GC Electronics. Q-Dope is available at electronics parts stores. I use it outside to keep the shack fume-free. After the coating hardens, strip enamel from ends of the leads and install the choke.

Be sure to delete the 680-ohm drive resistors (R24-R27) in the control unit, replacing them with jumper wires. They are no longer needed because this function is performed by R101-R104 in the antenna unit. If your control unit has an A-suffix part at U5 (such as CD4049A or MC14049B), replace it with a B-suffix part to get adequate current drive.

Upcoming installments of "Homing In" will go into more detail on the wideband performance of the new switching circuit. I will describe a UHF version that works great, according to a reader who tested it, and I'll explain how to space the whips and pick components to cover your favorite frequency range.

From the Mail Room

Thanks to all of you who have sent me your RDF news and inquiries over the past 75 months. I have tried to respond personally to every letter and E-mail message in a reasonable time, but in a few cases, I couldn't because the writing was illegible. If you have

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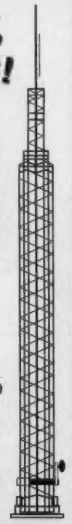

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been waiting for a reply for over a month, try again. Your E-mail may have been lost in cyberspace or I may not have been able to decipher your address.

Unlike Congresspeople, *73* authors don't have franking privileges. We buy our own stamps and stationery, so all of us appreciate the courtesy of a self-addressed stamped envelope (SASE) for the reply. I put letters with SASEs at the top of the pile, for earliest response.

For me, electronic mail is faster and better than postal mail. To better cope with the increasing E-mail volume, I have changed the Internet gateway for this column to America Online. My address is now HomingIn@aol.com. I will be closing out the old Portal address soon, but will remain on CompuServe (75236,2165).

The *73* typesetting computer has a mind of its own when it comes to putting hyphens at the end of text lines. In the December 1994 and February 1995 issues, it added them to a couple of Internet addresses, causing frustration to some readers. No matter how these paragraphs get formatted this month, remember that there is one dash in fox-list@netcom.com (the Internet RDF mailing list), but no dashes in listserv@netcom.com (the subscription address for fox-list) or in my Internet address.

Resources Mentioned in this Article

Roanoke Doppler boards:
Tom Lewis AB5CK
6721 Rolling Hills Dr.
North Richland Hills TX 76180

Marty Mitchell N6ZAV
340 Otero
Newport Beach CA 92660

ELNEC antenna analysis program:
Roy Lewallen W7EL
P.O. Box 6658
Beaverton OR 97007

PIN diodes and other components:
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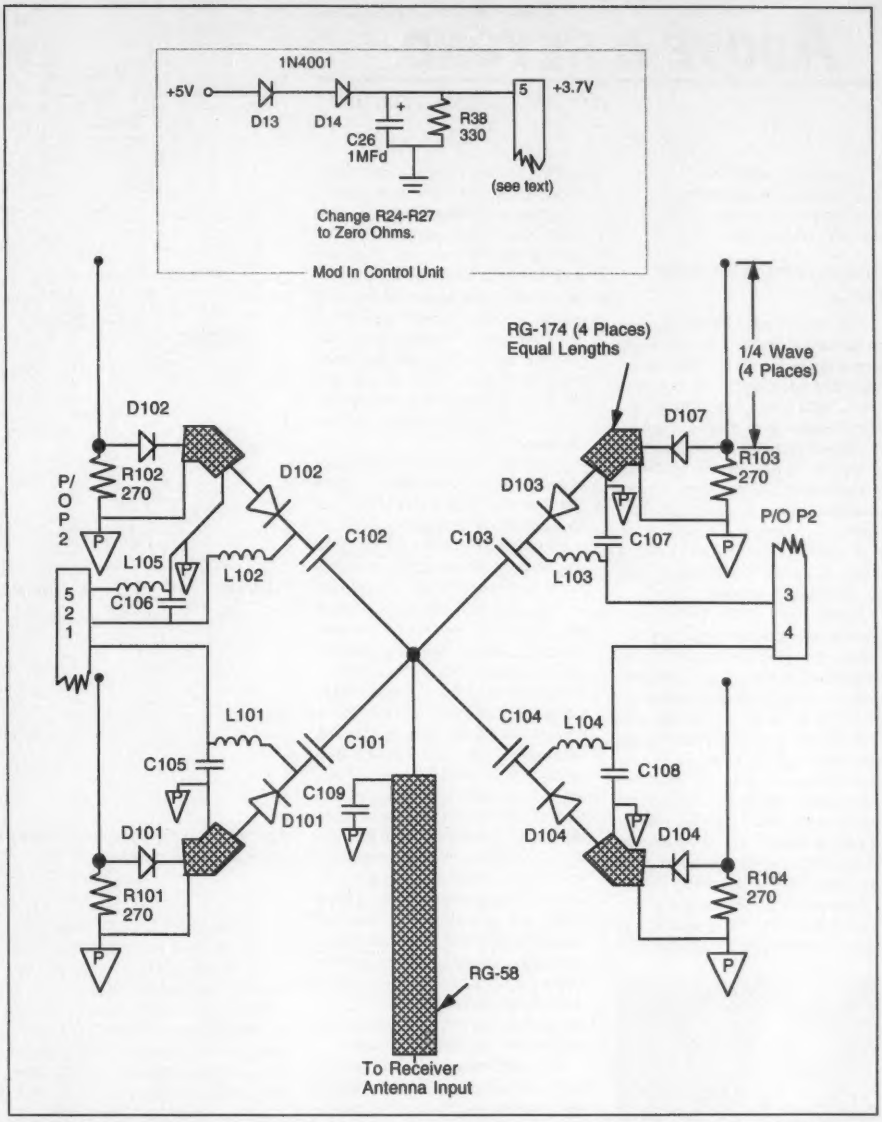

Figure 3. Schematic diagram of the new wideband switcher for the Roanoke Doppler. The P-in-a-triangle symbol denotes a connection to the ground plane sheet. Components values are for an array centered on 2 meters. All capacitors except C26 are 680 picofarads. See text for data on D101-D108 and L101-L105.

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Converting the TV Tuner, Part 2

This month I will cover the frequency stability application or synthesizer control circuit for the CATV tuner, as discussed last month. The main reason to include a synthesizer for frequency control is to remove a wobble in the local oscillator. When the mode of operation is ATV and the bandwidth is 6 MHz wide, stability is not a major concern. However, it is a nice addition, allowing us to only use a TV tuned to a particular channel to receive a known frequency. It eliminates a hassle: frequency uncertainty.

Another use of the CATV tuner would be in a spectrum analyzer application requiring the addition of a sweep/ramp board circuit. Usable frequency coverage with this basic tuner would be 50 MHz to just over 400 MHz with the stock CATV tuner. I will leave this project up to you for now as I have enough irons in the fire at this point. Maybe one of our readers will want to put a circuit together. I would be glad to include any information on this application when it becomes available. Back to the synthesizer.

After sitting down and starting to develop the circuit for a synthesizer control, I abandoned the attempt. The solution hit like a brick—I had developed this circuit many years ago and it is just as applicable today as it was then. The circuit used a Motorola MC-145106 PLL chip and it controlled a similar VCO in the 500-1000 MHz range. Well, I looked that project up in my file and all the work was done, even the script. However, it's not all rosy as it is in a CPM computer format that doesn't permit ASCII transfer, so I still have to rewrite the description. Well, let's hope it gets better the next time around.

The synthesizer circuitry is not complex as it only requires four transistors and an 8 MHz crystal for time-base reference. Frequency selection is made by an 8-pin mini DIP switch to programming diodes attached directly to the Motorola MC-145106 synthesizer chip. (For one-frequency control, wire the specific lines to VCC and omit the switch and diodes.) Two transistors are used in a lock/unlock LED indicator circuit, giving you visual "lock" indication. The other two transistors elevate the control voltage from the synthesizer chip to the +20 volt level needed for the VCO "VT" control voltage in unmodified tuner modules. The Motorola chip is not capable of working at a voltage of 19 volts or so, making the transistor interface necessary with higher control voltages. A modification to this scheme is to use a lower control voltage and eliminate the interface transistors from the circuit. I have marked this interface decision point on Figure 1 by an asterisk, "*." Pin 7 by itself will provide control voltages from DC to about 5 volts. The interface will provide from DC to about 20 volts.

The synthesizer diagram provided here is for use with a divide-by ratio of 256, sampling the VCO. Other ratio dividers (128, 64, etc.) are also usable. By making use of different reference division ratios and time-base selections a whole field of options are available. I selected an 8 MHz crystal and divided by 256 to demonstrate the synthesizer functions. A multitude of clock frequencies are possible, it's just that with an 8 MHz crystal the synthesizer will step in 2 MHz steps over its lock-in range.

Programming pins on the Motorola synthesizer chip count backwards, with pin 17 having the least BCD value and pin 9 having the most BCD value (the BCD value for pin 9 is 512; pin 17's is 2). The minimum increment this scheme can be set to is every even MHz; an odd frequency, such as 603, is not possible.

In this scheme I used an 8 MHz crystal for the reference. The BCD value to be programmed into the synthesizer chip is the operating frequency. So, if we desire the LO to operate on 902 MHz, the BCD value should be "902." Consult Table 1 for the pin vs. BCD value of the Motorola MC-145106 synthesizer chip. (Art K6UQH's synthesizer control uses a crystal at 10.47 MHz, allowing lock of a 1067 MHz frequency for the TV normal channel selector control to be used to select stations on 1200 MHz ATV. Check the data sheet on the PLL chip for other frequency schemes).

Interconnections between the synthesizer chip and the CATV tuner are minimal. The "PS" line, or pre-scaler output, should be made with a short length of coaxial cable such as RG-174, a mini-diameter cable, and wired directly to the Motorola VCO frequency input. Circuit losses at this point will cause the upper frequency operation to suffer. Use a good ground between the CATV tuner and the synthesizer in addition to the coax ground. Make all RF connections as short as possible by mounting the PLL as close to the PS line as possible.

The frequency-select BCD switch

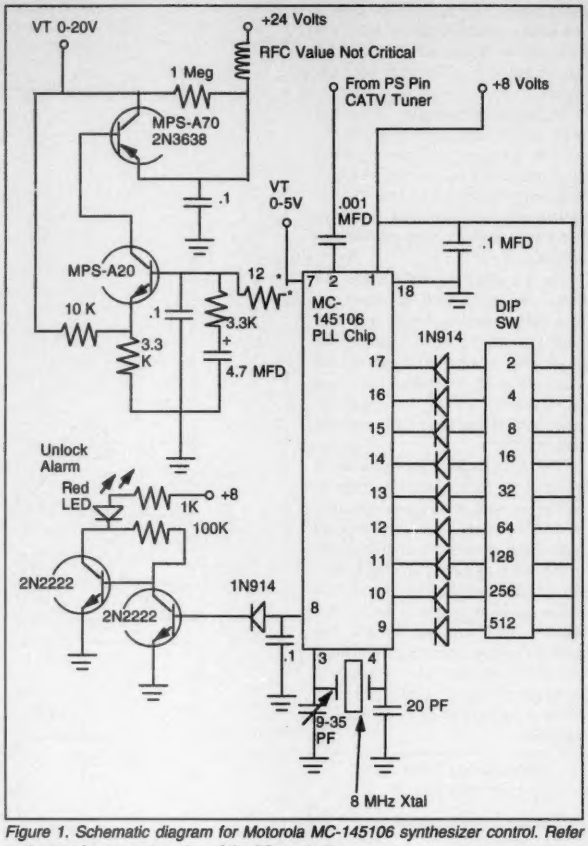

Figure 1. Schematic diagram for Motorola MC-145106 synthesizer control. Refer to the text for an explanation of the "" on pin 7.*

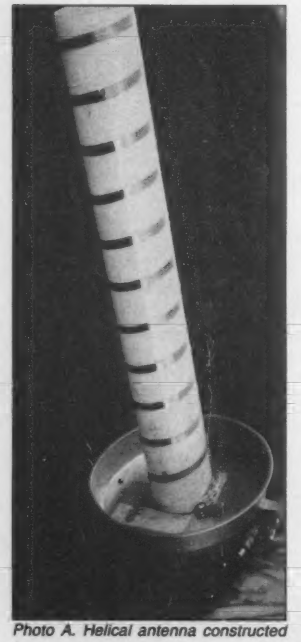

Photo A. Helical antenna constructed for this test. Note pie tin used for helical antenna reflector element.

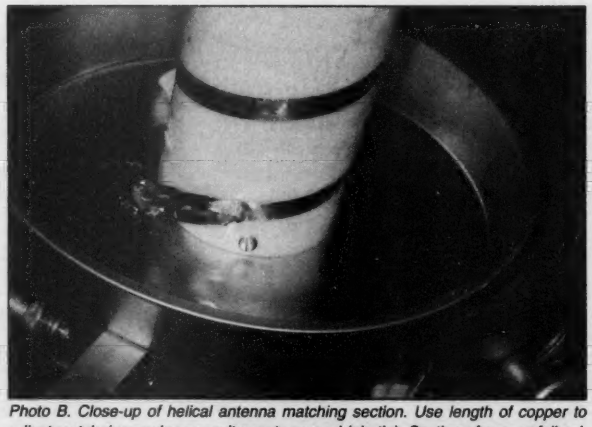

Photo B. Close-up of helical antenna matching section. Use length of copper to adjust match, by varying capacitance to ground (pie tin). Section of copper foil soldered near coax connector and on helical line.

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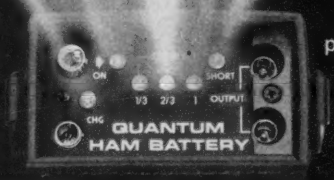

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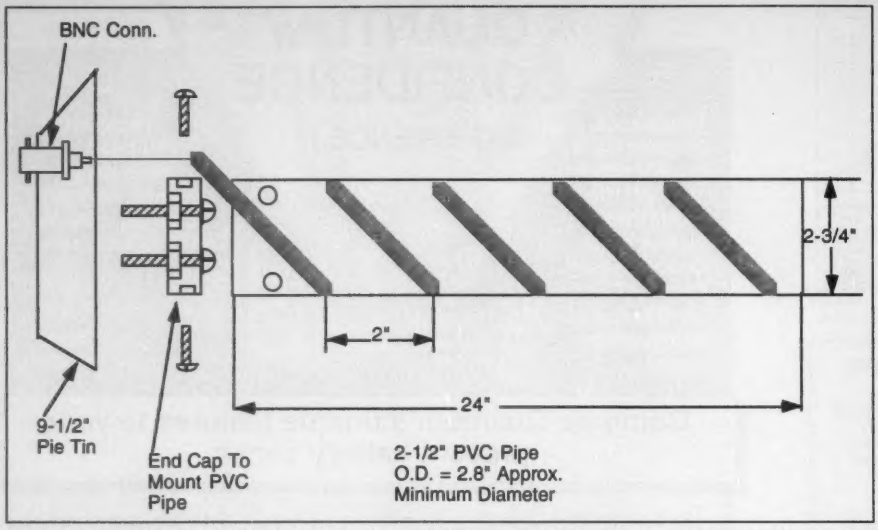

Figure 2. Construction details for the helical antenna for 1240 MHz. Wind a helix right-hand spiral spaced 2" between turns. Use copper foil tape 3/8" wide. Mark off 2" lines to aid in positioning tape on the PVC pipe.

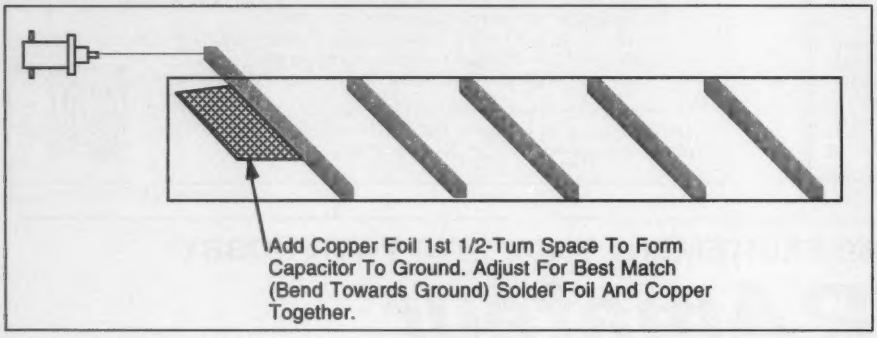
Add Copper Foil 1st 1/2-Turn Space To Form
Capacitor To Ground. Adjust For Best Match
(Bend Towards Ground) Solder Foil And Copper
Together.

Figure 3. Matching capacitor and coax connection section for the helical antenna (matches 140-ohm helix to approximately 50 ohms for coax feed).

can be any type of switch; I used a small rocker "option type" switch for circuit demonstration. You might want to keep it in the circuit, especially if you want to set the VCO to other frequencies. It's only a matter of frequency agility and your call. In his converter, Art K6UQH hard-wired the VCO synthesizer pins to set 1067 MHz programming. In his setup he switched repeater frequencies with the IF system, his TV receiver. By moving the TV channel selector he could cover 1240 to about 1276 MHz by going from TV channel 7 to 13. That equals going from 174 MHz (Ch. 7) to 210 MHz (Ch. 13) in the IF system receiver.

I think that most folks will follow the basic approach and provide a converter that is controlled from +12 volt operation, and use a calibrated pot to set frequency, making the simple version the one of choice. In this application, if frequency drifts somewhat you can just go to a different TV channel or reset the "VT" tune line voltage. If good regulation and filtering is used, this drift should be minimum for TV applications to allow a tune pot to be locked at one setting for good results.

In any case, Figure 1 shows the schematic for the synthesizer if you care to follow this method of frequency control.

Another use for CATV tuners is to make spectrum analyzers out of these units. Coverage would be from 50 to just over 400 MHz and the units could be used as is. For this application you would have to construct a sweeping voltage ramp generator. This sweep generator would control the external horizontal input of a standard o-scope and also drive the "VT" line for frequency sweep. Both the o-scope and "VT" sweeps would be in concert with each other to allow display of the resulting output. The IF output would have to be amplified and logarithmically detected before applying the IF signal to the vertical amplifier of the same o-scope. If I have time I will put something together but for now I'll leave this application up to you.

The 1200 MHz Antenna

An antenna for this frequency band can take several forms, and it can be purchased or home-constructed. The *ARRL Handbook* has shown several designs that can be reproduced, such as the loop yagi. For quite sophisticated antennas a large dish with a coffee-can feed could be used for the 1200 MHz band. If you want to purchase an antenna or parts I suggest you check out Down East Microwave, RR 1, Box 2310, Troy, ME 04987-9721; (207) 948-3741. Bill W3HQT has a variety of antennas and other material for the VHF-to-microwave bands.

If you want to build one on a limited budget and still obtain one that performs with minimal test equipment I suggest you construct a spiral helix. A spiral helix is a short length of wavelength-diameter spiral (coil) that is fed with coax on one end and open on the other. Think of this antenna as a child's "slinky" extended in an open-air coil-like fashion. (A slinky just happens to be about the right diameter to provide gain at this frequency; copper or similar material is better). The beauty is that the helical or coil does not have to be very long as compared to a yagi or similar antenna.

A helix about two feet in length has about 12 dB gain and a beamwidth of about 34 degrees. Adding another two feet in length only increases the gain a dB or so, but decreases the beam width not quite by half. This one fact makes short helixes a simple good-gain wide-frequency antenna to construct. If you want to build up gain in the helix, combine two of them to increase basic gain by about 3 dB.

One problem with the helix is that its feed impedance (one helix) is in the order of 125 to 140 ohms. Feeding two antennas of similar 2' lengths with a split half-wave phasing line will reduce the junction feed impedance to about 60 to 70 ohms. This makes a better match to the coax feedline. Other methods can be used, such as building out the capacitance to ground with copper tabs at the coax connector, will transform/adjust the match from the helix's 140-ohm feed impedance to the 50-ohm range. With a helix transformed to 50 ohms, a simple coax connection is all that is necessary for use.

An advantage of the spiral helix is that its construction is very forgiving in terms of assembly methods or errors in construction. Helical antennas exhibit very wide frequency coverage with good results. I connected the 30 dB preamp (Qualcomm) directly to the helix antenna and noticed the frequency spectrum in the 800 to 1000 MHz range come alive with activity. By rotation of the helix on stations in that frequency range I was able to observe about 12 dB gain when the helix was pointed in the direction of the transmitter. These tests were made inside my garage with the helix about three feet off the deck. As time permits I plan to mount a 1200 to 1300 MHz filter on the antenna before the preamplifier to minimize the effects from cellular and 900 MHz transmitters which are quite prevalent here in San Diego.

Helical Antenna Construction

A helix reflector is constructed using a sheet of copper PC board material or sheet brass (the brass is most expensive) cut two to three wavelengths square. This is the reflector element of the antenna and serves for the back-mounting of circuitry and support for the helix. I used a metal baking pan 9-1/2" round for the back reflector of my helix and it works well and only cost 99 cents. The actual helix coil is wound on a plastic 3" o.d. PVC pipe. The antenna that Kerry N6IZW and I made used the 3" plastic drain pipe 2' long. Standard 2-1/2" PVC pipe has an o.d. of about 2.8" and is very acceptable. The bottom end of the PVC pipe is firmly attached to the center of our reflector/baking pan.

A plastic or varnished wood plug can be fastened to the inside of the PVC pipe and used to secure the assembly to the inside of the reflector. Mount the bolts to secure the end cap to the reflector before securing to the PVC pipe or else you will have to obtain a 2-1/2'-long screwdriver to do the job. The helix is wrapped with copper tape spaced 2" inches apart radially

up the tube. The bottom end is connected to a coaxial connector at the base end of the helix about 1/2" from the bottom of the coil. I tried several matching schemes, including one using a 1/4-wavelength section of copper foil to attach to the coaxial connector and the bottom of the helix. It used a Teflon strip (shown white in Photo A) with a thickness of 0.010" to insulate the capacitance 1/4-wavelength strip from ground. I tried that method but dropped it in favor of the simple connector and foil gimmick capacitor shown in the photos. The simpler strip worked well and is easier to reproduce.

The transmission line spaced on the 0.010" Teflon was dropped as a method to adjust the helix as others trying to duplicate the antenna would have a hard time trying to locate 0.010" Teflon. Besides, the simple copper tabs don't look as nice but work just as well.

Another method is to ground the helical coil and feed a 50-ohm coaxial connection as a tapped turn on the helix. I haven't tried this method. In any case, there are several methods to try to obtain the best system you can construct. The choice depends on your construction methods and the materials on hand. I constructed several antennas for test purposes and settled on the simple connector and copper gimmick capacitance tabs that I previously described as the easiest to duplicate and construct. This antenna is very forgiving in its measurements and construction techniques. I haven't tried it for transmitting as of yet but for receiving it works quite well in the tests I have performed.

Outside tests here in California should have been quite easy, with the exception of during the rainy season that is dumping on us with little letup in sight. My tests will have to be limited to garage tests and signal reception from this limited location for the time being. Check Figures 2 and 3 for the actual dimensions for the helix antenna construction. Some variation in dimension accuracy is OK; I used the fudge factor of 10% as being acceptable. You do not have to have a micrometer to lay out the construction. Use a PVC or similar plastic pipe—*that's white PVC, not black.* I suspect that black might be OK, but it might have an effect on RF. Diameters for 1240 MHz are of from 2.75" to 3". (The o.d. of 2.5" PVC pipe is just about 2.8". Spacing between turns is 2"-2.1". I wanted a short low-wind resistance helix and I selected a length of 2' long. That gave me 11 turns on the helical coil.

A simple approximation of beamwidth can be obtained by dividing the number of helix turns into 385. In this case, 11 turns equals 34 degrees of beamwidth. I estimated gain to be in the 10 to 12 dB range. Mounting arrangements were made by attaching a 12" section of aluminum angle bracket to the back of the pie tin. This stiffened up the tin reflector and made a mount to attach to a mast or other tower mount. I located the filter and preamplifier up at the antenna on the angle bracket. A secondary preamplifier will be used in the shack when I get time to mount the antenna. The copper tape (3/8" wide) was secured to the plastic pipe with one length of double-sided tape to hold the individual turns during winding. After the turns were properly on the pipe I covered the entire assembly with 2"-wide thick packing (Scotch-type) clear tape. This will weatherproof and hold the copper tape on the PVC pipe for quite some time.

MC-145106 pin numbers:		
17	16	15
14	13	12
11	10	9
BCD value:		
512	256	128
64	32	16

Table 1. BCD value vs. pin numbers. Pull pin high to VCC to enable proper BCD value count.

Well, that's it for this month. I hope you have enjoyed the 1240 MHz ATV and other aspects of this project. Next month I plan to cover SWR as it applies to both VHF and microwave. If there is space I'll add some easy-to-assemble filters for 1 to 5 GHz.

Parts availability is still good and I will make the RF tuner with a Qualcomm preamp available for $25 postpaid; additional tuners or preamps add $10 each. (California destinations add state tax). As always, I will be glad to answer questions on this and other related subjects. Please send an SASE for prompt reply. 73 Chuck WB6IGP.

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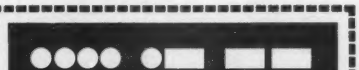

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A Cure!

In a recent column, I printed a letter from a ham who was having trouble with touch lamps. Now, we all know how annoying those things can be, with their harmonics all over the radio spectrum. This unfortunate soul, however, was having the reverse problem: His transmitter was turning lamps on and off all over his apartment building! I promised I'd print a cure if any reader had one.

Good ol' ham ingenuity came to the rescue! Leo AC4DA has grappled with the touch lamp monster and won. He was kind enough to give me permission to print his fix, so here it is. I have no opportunity to test it, but it makes a lot of sense, and Leo clearly knows his stuff, so I'd be awfully surprised if it didn't work. Here's an excerpt, with some paraphrasing, from Leo's letter:

A touch lamp consists of an oscillator with the output attached to the lamp base and shade frame, a circuit that detects a shift in oscillator frequency when the lamp shade antenna is touched, and a switch circuit to turn the bulb on and off.

I checked a lamp and found the oscillator frequency to be 244 kHz, with many strong harmonics. My corrective method is to tune the oscillator output to the lamp shade antenna with a Pi network. This peaks the fundamental and sharply reduces harmonics, which greatly reduces interference from the lamp to TVs and radios. It also sharply reduces incoming signals *to* the lamp, which is the goal here. The lamp circuit is decoupled even more from incoming signals by the addition of an attenuator resistor in series with the antenna lead. (Also, considering the unpredictable impedance of the "antenna," the resistor probably helps keep the antenna reactance from disturbing the filter's action—KB1UM.)

To find the lamp's oscillator frequency, connect a clip lead between the lamp shade and the antenna input of a receiver which can cover such low frequencies. Then, tune around until you find the signal; it won't be hard. (To be on the safe side, I'd try loose coupling with some wire near the receiver's antenna. If direct coupling turns out to be necessary, at least use a small-value capacitor, perhaps a couple of hundred pF, in series, to avoid any AC line currents which might blow your rig's front end out the window—KB1UM.)

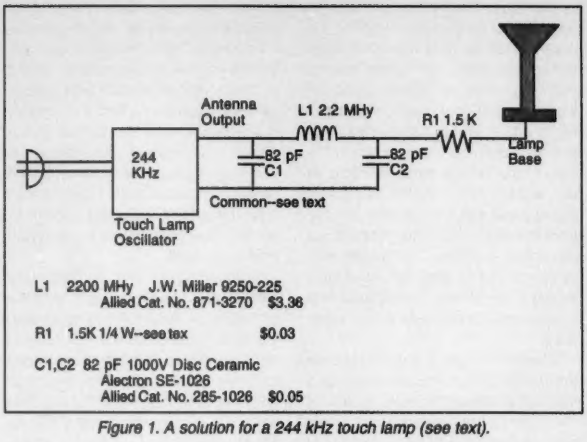

Figure 1. A solution for a 244 kHz touch lamp (see text).

Once you know the frequency, you're ready to make your filter. To install it, you must locate the lamp's oscillator output lead; it's the one that attaches directly to the inside bottom of the metal base. The Pi network shown in Figure 1 was designed for my 244 kHz lamp, but it can work with other frequencies if you use variable components. Simply tune both caps and the coil for maximum signal on the receiver's S-meter. Naturally, if you have a scope, that makes things even easier. (If you don't have a variable coil, you still can probably get plenty of frequency range with the two variable caps—KB1UM.) If the signal overwhelms your receiver, either switch in its attenuator or move the lamp's output farther from the radio's antenna input.

A different L-to-C ratio could be used; I used what I had available. C1 and C2 are rated for 1,000 volts DC because the lamp circuit's common "ground" to which they are connected

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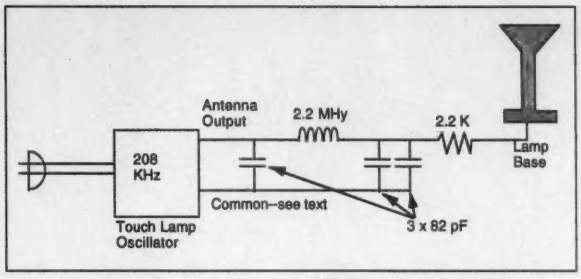

Figure 2. A solution for a 208 kHz touch lamp (see text).

may in fact be one side of the AC line! Don't skimp with lower-rated caps or you could create a serious shock hazard.

Start with 5k ohms for the attenuator resistor R1 and see if the lamp still turns on and off when you touch it. If not, reduce the resistance value until it switches consistently. If your lamp is at another frequency, some experimentation may be in order. When I modified another lamp, which was at 208 kHz, I had to add another 82 pF cap across C2 and change the attenuator resistor to 2.2k ohms, as shown in Figure 2.

This was a simple but satisfying project. The best part? My wife is pleased with it!

Thank you, Leo, for a well-thought-out solution to a vexing problem. I've been hearing about these darned touch lamps for years, and yours is the first reasonable cure I've run across. Good job!

Other Kinds of Interference

This discussion of touch lamps makes me think about other kinds of interference. One problem I've run into many times is harmonic output from switching power supplies. The ones in desktop computers are usually completely encased in metal, so they don't make much, if any, noise. And, their output leads are confined within the computer's metal case, so no RF gets out that way either. The only exposed item is the AC line cord, which seems well enough filtered that it's pretty quiet. Other kinds of switching supplies, though, often have little or no shielding, and they can make quite an RF racket. The little one on my fax machine is a doozy, and my camcorder's charger/adapter is even worse. Both of these supplies are in plastic cases, with only a small internal shield.

Is there a fix? Unlike with the touch lamps, the output of a switching supply cannot be interrupted with a Pi network filter. At least, not as far as I know. You'd need a very low-resistance, high-current inductor which could handle lots of current. And, many switches malfunction if there's a lot of inductance on the output line. So, electrically, you're in a bind. The only cure of which I am aware is mechanical shielding. A good metal box and perhaps a toroid around the output lines can help. Frankly, I haven't been very successful at quieting these things down.

And what about microprocessors? Everything from my fax to my VCR radiates some amount of wideband noise, thanks to the digital goodies inside. By their very nature, digital signals are rapidly rising and falling pulses, which means lots of RF hash all over the spectrum. It's not real strong, but it can be strong enough to get into a ham receiver, a TV or a shortwave, especially with an indoor antenna. Electrical filtering within the offending box is pretty much out; you can't stop the pulses or you stop the digital device's operation. You can, of course, shield the device in metal. Also, lines coming in and out can be filtered with toroids. Much digital noise is pretty high in frequency, so those toroids can really make a difference. In fact, they're one of the few fixes I've ever actually seen work.

Hello? Hello?

Telephone circuits can be very susceptible to RF fields. The phone company does sell filters which can help quite a bit. But, with today's all-electronic phones, QRM to telephones has gone up, thanks to all those nice, rectifying diode and transistor junctions in there. With the old phones, the only active circuitry was in the touch pad; the voice circuits had nary a single transistor, so it was pretty hard to induce a signal. Ah, the good ol' days!

Cordless phones and baby monitors are another matter. Most operate in the 46/49 MHz band, which is pretty far from our operations, except perhaps for 6 meters. I've never seen one get into ham reception, but I have seen nearby transmitters of various kinds get into the phones. In fact, I saw one case where a mysterious pulsing noise was coming from a baby monitor's receiver. Thanks to my ham training, I recognized the pulses as Morse code! The letters made no sense, though, and I guess I'll never know where it was coming from. But it sure was weird to hear it on a baby monitor at 49 MHz.

Well, that's it for this month. Until next time, happy interference-free communicating and 73 de KB1UM.

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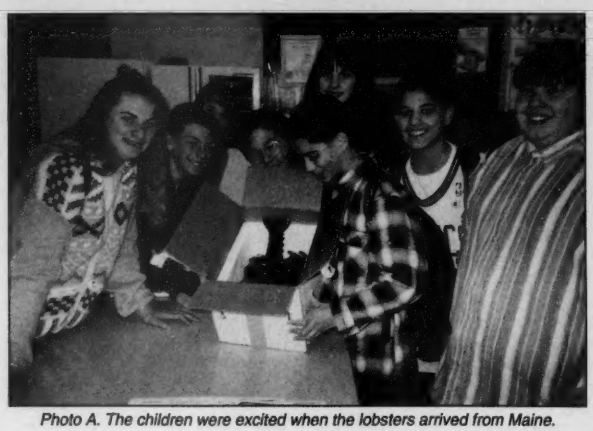

Photo A. The children were excited when the lobsters arrived from Maine.

Getting a Taste of Radio

As the delicious aroma of broiled lobster wafted down the hallways of Intermediate School 72 in Staten Island, New York, every child in our school wished that he or she could be in the ham radio program. When the "Eyewitness News" television camera arrived, it looked like a rock concert crowd outside my classroom door. How did this excitement get generated? Through contacts on the radio, of course.

In early fall, Jim Wilmerding N4MDC and I worked out the schedule for what we believed would be some exciting school contacts that term. Little did we know the level of excitement we were igniting. Jim is the Project Director of the Island Institute Schools in Rockland, Maine. A dear friend for many years, Jim and I have always shared the philosophy that using ham radio to stimulate interest in school curricula is almost always a terrific experience for the students. Since the Island Institute offers educational resources for the 14 island schools in this scenic part of Maine, Jim knew that introducing ham radio to the small island schools would be a great educational experience for those students, and for mine as well.

One of the first small fishing islands we spoke to was Frenchboro. This island has a one-room schoolhouse with eight children in grades K-8. Imagine my trying to describe this to my 13 ham radio classes in grades six, seven, and eight. Our total school population is 1,800 plus. When the children first made radio contact they all appreciated the fact that even though both schools were located on islands, Staten Island was very different from Frenchboro Island. The differences and similarities became the focus of most of our contacts during the next few months.

Filling in the Picture

My students came up with the idea of sending souvenirs, videotapes of our school, scrapbooks, and reports about Staten Island and New York City to their counterparts in Maine. I chose a team of students to take video footage of our physical education classes in the gym, our assembly programs, our shop classes, the school cafeteria, and various classrooms. The favorite footage of the children at Jim's end seemed to be our kids speaking with them on the radio. They also got quite a dose of "culture shock" when they saw footage of 563 sixth-graders all having lunch together. Many "oohs" and "ahhs" were reported from both ends as a wonderful letter exchange began between the two groups.

We have also made contact with four other island schools in the system. My students have had the fun of speaking with children at the Longfellow School on Great Cranberry Island, the Islesford School on Little Cranberry Island, the Swan's Island School, and Chebeague Island School. All my students got so caught up with the excitement of the contacts each week that a spontaneous outpouring of the most wonderful scrapbooks began to arrive in my room. Students put together scrapbooks showing all the fast-food restaurants, supermarkets and movie complexes on Staten Island. Several youngsters did a project showing the various stores and attractions at the Staten Island Mall. We collected maps, brochures, travel folders and family photos all depicting a young child's life on our island in New York.

One of the best projects was that of two students who videotaped a trip into Manhattan as seen from the Staten Island Ferry. Jim's kids were so amazed to see that the largest ferry, the *Samuel Newhouse,* carries up to 6,000 passengers. The smaller ferries carry up to 1,280 passengers and 40 vehicles. The five-mile ride past the Statue of Liberty, Ellis Island, the Verrazano Bridge, and other famous landmarks was recorded on tape by my students.

All the children's projects were shipped out in large cartons to Jim for distribution amongst the island schools. According to Jim and to the island teachers I spoke with, they were simply overwhelmed at the wealth of information collected by my students and forwarded to them.

Next began the wonderful reciprocal exchange between the schools. Jim sent us photos of the various island schools, along with a videotape showing the island children on board their fathers' fishing boats. My classes sat mesmorized as they watched kindergarten and first- and second-grade youngsters handling lobsters and crabs as they explained how the traps were constructed and used. All the geography and social studies books about Maine could not have had the educational impact on my students that the letters, books, tapes, and radio contacts did. They were talking about things they learned to their other classes. Other teachers reported back to me how excited the children in the ham radio program were about what they were doing and learning with the kids in Maine.

Lobster for Lunch

Unbelievable school-wide interest and excitement broke out when Jim announced on the air one day that he would be sending us six live Maine lobsters. I enlisted the help of Ms. Sheilah Sukhedeo, our home and career skills teacher, to do a team teaching (and eating) lesson with me. I chose one student from each of my 13 classes to participate in the "Lobster Fest." One of my seventh graders, Billy Daddio, volunteered his father, who is a chef, to help us out. We also invited several parents from our supportive PTA to join us at the table.

The Maine Lobster Promotion Council sent us a carton of goodies that really added to the festivities that day. They sent lobster pins, caps, posters, nutritional guides, and recipe books for the children. They even included lobster crackers and an apron for the chef. Ms. Sukhedeo and Mr. Daddio did an incredible job showing the children how to prepare the lobsters and then how to cook them. They were both so knowledgable that it became one more incredible learning experience for my students. Three children had never seen or eaten lobster before.

A local restaurant, Real Madrid, donated colorful lobster bibs for everyone. Parents provided side dishes to have with the lobster, and a fabulous table was set. Even the photographer and reporter from our local newspaper joined us for lunch. Parents, our principal Ms. Barbara Glassman, other administrators, teachers, and children; all breaking bread together as the culminating activity of a ham radio experience provided quite a picture.

After a delicious lunch prepared by the students, we went back to my room in time for the TV cameras to capture my children and the principal getting on the radio to thank Jim and Ron Cote, the principal of the Chebeague Island School, for sending us the lobsters. We even had a chance to thank Mr. Thomas, who packed and shipped the lobsters for us, on a later radio contact.

I do not know how this radio experience could have been any better from an educational and cultural point of view. I received "thank you" notes from some of the parents, who assured me that their children would always remember the Lobster-Radio Day and all the things they learned. Is there anybody out there who still doesn't see the value of ham radio in a classroom?

Photo B. After lobster lunch we went back to the ham shack to thank Jim and his students. (Billy Daddio at left.)

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NEVER SAY DIE

Continued from page 4

into. Health, education, crime, entertainment, the arts, and so on. Please note that I have not even hinted at your going into business making a ham product. I can't think of anyone who's gotten rich selling a ham product. We hams are famous for being frugal. A few hams have started out in the ham business and then gone on to make more commercial products with success. Tough way to start.

Read magazines and books. Look for new ideas which can be commercialized. When I was working as an engineer for Airborne Instrument Laboratories I ran across a chap who'd invented a great new microwave antenna. I pointed out that microwaves and audio had the same wavelengths, so he'd inadvertently invented a new kind of loudspeaker. We spent a summer developing a prototype, and then I set up a company and started making 'em. He stayed with AIL.

These days I see opportunities for new products and services at every turn. My problem has been finding the people I can depend on to follow through. There's just so much I can do by myself, and then I have to depend on others. That's been a major problem for me, so I do what I enjoy . . . starting new businesses, getting them going, and then I tend to sell them off to get out from under the need to keep managing them, which prevents me from being able to start new businesses. I really hate having to work with the financial reports, which becomes a full-time responsibility by the time you have a half dozen businesses.

Since I can't do it all, it's up to you to get off your . . . er . . . couch, put down the TV remote, and get busy starting new businesses. How many magazines are you reading a month? Well, I'm probably reading and checking through several times as many. How many books a month?

Auto-Ident

If you've been making any effort to learn about digital communications, you have a license to develop the new products we'll be seeing. I've discussed some of these in my past editorials, which you've let go into one eyeball and out the other. The time is not far off when we'll be building into our rigs an already available inexpensive chip which will identify our transmitters for us automatically. The next and obvious step is to design (and sell) a decoding unit for receivers which will completely change amateur radio. This will be an even bigger change than came about with repeaters, where we standardized channels and made it possible to make contacts with friends just by listening on one frequency.

With a receiver which can be programmed to alert us when someone is calling us, we're going to move into a new era. On the high frequencies we will be able to have our receivers tune the bands for desired callsign prefixes, or for the callsigns of friends. We probably should establish a few calling channels to be used for initiating contacts. When a contact is made the operators would then move to an unused frequency to carry on, freeing up the calling channel.

Now, you can wait for all this to happen, or you can be one of the entrepreneurs who develops the system and collects royalties on it from the ham gear manufacturers. Or you might, if you have the same defective genetic problem I have, go into business manufacturing the needed accessories.

With that kind of operation made possible we just might be able to attract more hams to our hobby. It'll help make hamming more like using the telephone, but with the advantage of almost unlimited groups getting together to talk.

Another innovation which it is about bloody time we started working on is duplex hamming. Lordy! Here we are in 1995 and we're still making one-way transmissions to each other . . . and over to you. That's stupid. In past editorials I've discussed several ways of solving this, but not one of you has, as far as I know, bothered to do one blessed thing. The telephone company has been able to provide duplex operation, even on overseas calls, for over 50 years, while we hams are just one small step ahead of buzzing each other with spark gaps, using our beloved Continental Code. It isn't Morse Code that we have been using, by the way. Instead of lying there on the couch guzzling beers and smelling the flowers, some of us would do better to sniff some Energine and get a move on.

> ***"Another innovation which it is about bloody time we started working on is duplex hamming."***

Where's Fax?

Just because the Japanese engineers who have been designing about 95% of our ham rigs haven't built in a fax jack so we can exchange faxes is no reason for you to sit there scratching your . . . er . . . ear. How about building a fire under your soldering iron and whupping up a circuit we can install in our radios so we can plug a fax machine into our rigs?

Wouldn't you like to be able swap diagrams, magazine articles, and stuff like that? If I see any signs of activity along this line I'll start the ball rolling by announcing that permission is granted to fax any pages from *73* over the air. This should help get around any possible copyright problems which might, but are unlikely to, arise.

I don't know about you, but when I read magazines I tend to tear out the articles I find of special interest. I've got two file drawers full of this stuff, all filed according to subject. I'd like to be able to answer questions I get over the air by not just explaining something, but also by being able to fax an article of two on the subject which the other chap will find interesting. I know that I'd be on the air far more often if we had something like that.

Readers now and then take the trouble to clip articles they think I'd be interested in. I read a lot, but I sure can't read everything, so I really appreciate getting articles on cold fusion, educational advances, health care advances, ham radio, submarines, ragtime, and so on. Until we get fax working with our ham rigs, use Sam's Snail Mail.

Of course, once there's a way to swap clippings, I'll have to index mine and scan them in so I can have my computer send them without me having to find the right file folder and look through for the wanted article. Oh well, I have my books, CDs, and my videotapes pretty well indexed, so what's one more index?

That reminds me. Years and years ago (1930s) one or two of the broadcast stations (WOR was one) were sending newspapers by fax at night, but it never caught on. Now how difficult would it be to FM a broadcast band carrier (phase-shift) enough to run a fax machine? Radio stations could offer this as an additional service, right along with their normal broadcasting. One of the things I've been hoping to find time to do is try out a talk-show format for radio where I would discuss new music releases I think people would like, books, poems, and discuss solutions to our major social and political problems. With a fax system also available I could have the listeners get faxes of background material on the things I'm discussing. There's an awful lot of good stuff on the radio that is heard once and lost.

It wouldn't be long before we had fax tuners which would check all the local radio stations for faxes on material we program it to pick up for us. Our computers would save it for us to check. We could then print it out or just erase it.

Someone will probably develop such a system and make millions on the royalties. Put me down for 10% for the idea, okay? I described the first laptop computer to a Japanese friend of mine. He went to Kyocera in Japan and convinced them to make it just as I had described it to him. He then got Microsoft to do the software I'd suggested, and it's been the most successful laptop computer in history. No, I didn't get any money or even credit, and my friend stopped talking to me and is now a multi-millionaire. When I see whole magazines devoted to laptop computers, I enjoy knowing I had a part in their development. Oh, I know laptops would have come along anyway, so I just played a small part. But I get satisfaction out of knowing that I've helped a little to move the world along with cellular telephones, computers, music, and so on. How about you, what have you done so far? Do I have to come up with the ideas for you and then push and push to get you off dead center?

Here's Another Idea!

How about inventing a simple pair of roller skates that can be quickly stepped into . . . something like putting on skis these days? Make 'em light. The idea is to make it easy for people to put on the skates to get around town fast, and then take them off when they pop into a store, on a bus, or the subway. People need something like this to get around our cities quickly. It would beat the heck out of walking.

Not everyone knows how to skate now, but if a product like this were available, we'd have octogenarians skating. The next thing you know we'd see more streets closed off from vehicles and lanes for skating. I suppose we'd want both in-line and the old four-wheelers. I know I'd be right up front in line to buy a pair, and the shoes needed to mate with them.

I remember seeing a TV segment on the chap who invented the in-line skates. He got shafted by the manufacturer, so he's trying to invent another new product and maybe be a little smarter on the business end next time. If you know where I can get in touch with this chap, I have the idea he needs to make zillions. You could too, but I can't get you away from watching ball games on TV and wasting what's left of your life rag-chewing on 75m or the local repeater.

Your Other Legacy

Your wife is probably used to being a "radio widow," mostly getting to see the back of your head at the operating table. But are your kids radio orphans? Is your family really a one-parent family? A recent study showed that the average American father spends five minutes a day with his kid. Five lousy minutes? And then he grumbles about family values not being taught, and wonders later why his kid has "gone bad." OM, your kids are the most important legacy you're going to leave when you get your treasured Silent Key award from the ARRL. You better figure out some way to spend more time with 'em.

Read to 'em. Tell them stories. Find out what problems they're having in school, or even with you. Be a dad, not just that guy sitting there at the rig every night telling them to keep the hell quiet. The average kid spends three hours a day in front of the television. That's a terrible habit to give them for life. Start early and make TV a privilege, not a right. You might insist that they only watch videotapes. In that way you can guide their viewing

and not let them get hooked on stupid sitcoms and trash TV like Oprah or Geraldo interviewing 400-pound black lesbian mothers.

Get them interested in reading, in poetry, in classical music. Help them learn skills such as skating, ice skating, skiing, swimming, juggling, bicycle riding, some magic tricks, building electronic kits, using tools, repairing things. Do your children have their own desks and quiet place to study? Do they have a workbench, tools, and some test equipment? How about their own computers? And not for games. How about a chemistry set? How about painting? What musical instrument are you encouraging them to learn?

I've seen Novices of four, and an Extra Class girl of nine. Get your kids going and they'll be showing you how to handle packet traffic and make satellite contacts.

Yes, I know it's difficult to break your own habit patterns, so why not try to spend 10 minutes a day with your kid instead of five. It'll be a start. My father didn't spend five minutes a month with me, and I've never forgiven him.

Well, that's enough lecturing. Now stop screwing up. Start reading some of the books I've been recommending. Did you get *Kinship With All Life* yet? If your kids are young, start reading the Oz books to them. I've been wanting to put these all on tape for kids for a couple of years now, but there never seems to be time. I've got every one of L. Frank Baum's Oz books. Did you see that wonderful TV movie they did of him a few years or so ago? I've got it on tape so I can see it again now and then.

I also want to tape all of Ernest Thompson Seton's animal stories. They're fabulous and I've got most of his books. For adults I want to do tapes of the Kai Lung stories by Ernest Bramah. His books are terrific. Sigh.

But then, as I walk through my library I see book after book that I know you would enjoy. Benchley, Stephen Potter, H. Allen Smith, Parkinson. It's even worse when I start going through my CD collection. You ought to hear this . . . and so on.

Raising the best possible kids you can is not intuitive. You not only have to overcome your own crummy training by your parents and the great American school system (which is a disaster of major proportions), you also have to fight against the currently entrenched systems for dealing with children. And then there's the peer-pressure monster.

I've covered much of this in my book *Declare War* and the updates, which I'll eventually put together as a second book. I should do a book just on how to raise the best children you can.

Children, like dogs, are programmed to please (called instinct), but unless you take the time to give them the training they need and want, they'll cause you and themselves trouble.

Now, how come your nine-year-old children or grandchildren aren't Extra Class hams? Why are they dressing in peer-induced clothes? Why are they listening to rap and punk rock instead of classical music? Hey, they're what you've made them. Or neglected to make them. Five minutes a day, eh?

No More Novices?

What do we really need the Novice Class license for now? Now that we have the no-code Tech Class license, the only major difference between that and the Novice Class exam is that the technical questions are a little harder.

Old-timers who predate the Novice license may remember that the whole purpose of the license was to give newcomers an easier way to learn the code. The idea was to start them slow at 5 wpm and let them build up their speed by getting on the air in the Novice CW bands and build up to 13 per.

Two things have changed since then. Two important things. Important enough to get the FCC to reconsider the value of the Novice license. First, with the value of the code approaching zero as far as providing trained operators for the military in time of war, which was one of the original reasons for maintaining the code requirement, there is no valid reason for continuing to demand that all newcomers develop code skills. Yes, until the ITU removes the requirement for "a knowledge of the code" we'll have to make sure that licensees have that. But this is fulfilled by a 5 wpm test, and I now have a booklet out which explains how anyone can pass the 5 wpm test with less than one hour of training. Most people can do it in 20 minutes. (See the ad on page 67.)

The Continental Code (we don't use Morse) is as passé today as spark transmitters. Oh, I'm not putting CW down as a fun mode. I'm just pointing out that it has no practical use in the world of 1995 other than as a fun reminder of the long past which lives on in amateur radio and Newington.

Note that I am not going to say one single word about the effects of keying a powerful transmitter on and off near the human body may have on the operation of that body. Nor am I going to upset Extra Class hams by pointing out that although virtually all hams are crazy, by far the worst offenders are Extras. I would never say that, since some of my worst enemies are Extras.

Oh yes, the second basic reason why the 5 wpm Novice code speed is stupid. One of the reasons millions of potential hams have been kept out of the hobby has been the code skill requirement. This began to break down when the Novice license was initiated.

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Before that we all had to start out at 13 wpm. One thing we didn't know then was how the mind learns to copy the code. The system, from the beginning, was to start people off slow and gradually build up their code speed. This invariably led to the mysterious and infamous 10 wpm "plateau." Scientists didn't find out until fairly recently what was going on. Now we know that the graduated speed method is a major bummer.

As I've explained endlessly (well, it seems to me that it's been endlessly, but every time I bring it up at a hamfest talk it seems to be a news flash to most of the people present), when you start out learning the code the usual system is to learn the characters and then listen for the dits and dahs. Dah-dit-dit. Hmmm. Let's see, oh yes, that's a D. In computer terms you set up a look-up table in what's left of your mind after our school system has gutted most of it, and compare the dahs and dits with this. The problem here is that the table is on one side of the brain and your ears and hands on the other. The brain was probably designed that way to allow us to play the piano and other musical instruments without having to think about every finger movement. And to type.

When the brain reaches its clock speed, which is about 10 wpm, that's all there is folks. Plateau. Now you have to start all over and learn the code as you should have in the first place, letting your fingers write or type the characters when you hear the code patterns. No thinking allowed. Thinking just stops everything, as you've probably noticed when you miss a character. Then you miss a bunch before you get back on automatic.

In view of this understanding of how the brain works, you can see that the Novice 5 wpm test as a way to help newcomers get up to 13 wpm is not just totally unscientific, it's stupid and defeating to the whole purpose of the license class.

So let's do away with it. It's causing newcomers endless misery and is doing the hobby serious harm. When you look at it in this perspective the Novice Class offers zero benefits and is seriously damaging to amateur radio.

"So let's let the hams who want to use CW do it and stop using the code copying skill as a way to keep this an exclusive hobby."

Combining the Tech and General Class Licenses

Just as there is no rational reason for the Novice license, there's also no good reason in 1995 for demanding the 13 wpm test for the General Class license. So let's reinstate the same technical exams for Techs and Generals and thus be able to dump the Tech license. About the only use for the code these days, as I mentioned, is as a fun mode for hams. So let's let the hams who want to use CW do it and stop using the code copying skill as a way to keep this an exclusive hobby. What do I have to do, bring a class action lawsuit on behalf of the general public against the FCC and the ARRL to break this link with the distant past?

With us using about 0.13% of our allocated frequencies, and with our virtually unused ham bands the ones which promise the most value for us in the future, we're going to be big losers if we don't get in some youngsters to help populate our empty bands. With the average ham age being in the 50s, you know as well as I do that few of us older hams have the gumption or the time to pioneer new bands and modes.

The fact is that amateur radio paid back the public for the use of our bands when the average ham age was in the 20s and 30s, and since the League's Incentive Licensing brainstorm 30 years ago, we haven't been worth beans as far as our contributions are concerned. We've almost stopped inventing and pioneering. That takes youngsters.

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20 wpm code? Give me a break! For what? For a few lousy kHz of exclusive CW and phone bands. Big deal, 25 kHz on 75, 40, 20, and 15 meter phone. And ditto for CW on those bands. Let's cut out this elitist baloney. I'd eventually like to see one class of ham license, as I've mentioned before. Plus I'd like to see us experiment with removing mode discrimination on a band and see if it helps or hurts us. In the meanwhile, let's take an intermediate step and combine the Extra and Advanced Class licenses. We can do that by getting rid of the 20 wpm code test and using the current Extra Class technical test. This is supposed to be a technical hobby, right? Well, let's make it that.

We could rename the Novice-Tech-General Class license Class B, or Peon Class, and the Advanced-Extra as Class A, or Elite Class. Just kidding. Sorta. And if there are any militant political correctness jerks out there who object to me using the word peon, go jump in a nearby lake. Or a remote one.

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SPECIAL EVENTS

Ham Doings Around the World

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the April issue, we should receive it by October 31. Provide a clear, concise summary of the essential details about your Special Event.

APR 1

COLUMBUS, IN The Columbus ARC Hamfest will be held at Bartholomew County 4-H Fair Grounds, Family Arts Bldg., State Road 11, 8 AM-2 PM. Set-up Fri., Mar. 31st, 6 PM-10 PM. Talk-in on 146.790/.190. Make reservations through *Marion Winterberg WD9HTN, 11941 W. Sawmill Rd., Columbus IN 47201. Tel. (812) 342-4670.*

LEBANON, PA The Appalachian A.R. Group will host a Hamfest/Computer Show at Lebanon Fairgrounds, starting at 8 AM. VE Exams begin promptly at 9 AM (gather at 8:30 AM); pre-reg. requested. Lateness will result in disqualification. A fee payable to "AARG" will be collected at the Exam. Please bring original and a copy of your current license, and two forms of I.D. Registration deadline is Mar. 1st. Contact *Roger Engle WN3U, 979 Radio Rd., Elizabethtown PA 17022. Tel. (717) 367-2230.* Talk-in on 146.04/.64. Send check for Flea Market reservations to *AARG, 105 Walnut St., Pine Grove PA 17963. Tel. (717) 345-3780;* or *Lanny Hoffman KD3TS, 337 N. 19th St., Lebanon PA 17042. Tel. (717) 274-2148.*

LONGMONT, CO The annual LARCFEST will be sponsored by the Longmont ARC, 8 AM-3 PM, at Boulder County Fairgrounds, Hover and Nelson Rds. VE Exam at 1 PM. Talk-in on 147.27/.87 and 146.52. Contact *Randy Stevens N0NMD, 5280 Cypress Dr., Boulder CO 80303. Tel. (303) 499-1106.*

ROCHESTER, MN The Rochester ARC will sponsor their 18th annual Rochester Area Hamfest/Computer & Electronics Show. VE Exams. Flea Market. Speakers and programs. Contact *Rochester ARC, Attn.: Frank Ingram N0MXN, 1627 5th Ave. SE, Rochester MN 55904. Tel. (507) 288-6569.*

SPOKANE, WA The Eastern Washington SECTION Hamfest and Computer Show will be held at Spokane Interstate Fairgrounds, N. 404 Havana. The Inland Northwest Hamfest Assn. will sponsor this event 9 AM-5 PM. Setup Fri., Mar. 31st, 9 AM-6 PM. VE Exams. Seminars. Contact *Warren Kelsey KJ7BB, S. 1405 Crestline, Spokane WA 99203. Tel. (509) 534-8443.*

APR 8

FERGUS FALLS, MN The Lake Region AC will sponsor their 8th annual ARRL affiliated Hamfest, 8 AM-3 PM, at the Hocky Arena, Otter Tail County Fairgrounds. Set-up Fri., Apr. 7th, at 4 PM. VE Exams, ARRL Forum, MARS, Packet. Talk-in on 146.040/.640. Please contact *Wm. Morgan, Rt. 6 Box 43, Fergus Falls MN 56537.*

GREEN BAY, WI A Ham Radio & Computer Flea Market will be held at Ashwaubenon H.S., 2391 So. Ridge Rd. Sponsors: Ashwaubenon H.S. Tech Club and Brown County ARES. Set-up Apr. 7th, 7 PM-10 PM. VE Exams; register 8 AM-9 AM. Talk-in on 147.075(+). Contact *Chad Stiles N9PAY, 2171 Barberry Ln., Green Bay WI 54304. Tel. (414) 494-2936;* or *Lisa Kolbusz N9VJL, 520A Columbia Ave., Green Bay WI 54303. Tel. (414) 497-1807.*

JOPLIN, MS The Joplin ARC will hold HAMFEST '95 at the John Q. Hammons Trade and Convention Center, 3615 S. Rangeline (adjacent to the Holiday Inn). Time: 8 AM-3 PM. Set-up at 6:30 AM. ARRL Exams at 10:30 AM (pre-reg. not reqired). Bring original current license or CSCE, copies of license, and a photo ID. Talk-in on 147.210(+). For reservations and info, call *Larry Hendrix WB0OYU, (417) 782-5848 eves.,* or *Andy Gabbert KA0TUD, (417) 673-8371.* Address mail order requests for tickets to *ATTN: HAMFEST '95, Joplin ARC, P.O. Box 2983, Joplin MO 64803.* Must be received by Apr. 1st.

PORTLAND, ME The Portland (Maine) Amateur Wireless Assn. will sponsor a Hamfest and Electronics Flea Market, at the Univ. of Southern Maine, Sullivan Gymnasium, on Falmouth St. Doors open 8 AM-1 PM. Set-up 6:30 AM-8 AM. VE Exams 11 AM. Talk-in on 146.73/.13. Contact *Marty Feeney K1OYB, (207) 772-1682.*

WEST ORANGE, NJ A Hamfest will be held by the Irvington-Roseland AC, 8 AM-2 PM, at West Orange H.S., 600 Pleasant Valley Way. Set-up 6:30 AM. Talk-in on W2QR Rptr. 147.415/146.415; 146.520 simplex. Call *Jim Howe N2TDI,* or *Liz Howe N2WGH,* at *(201) 402-6066.*

APR 9

FRAMINGHAM, MA The Framingham ARA will hold its Spring Flea Market and VE Exams at Framingham H.S., A St. Doors open 9 AM for early bird buyers and 10 AM to all buyers. Set-up starts at 8 AM. To reserve tables, contact *Lew Nyman K1AZE, (508) 879-7456.* Send check payable to *FARA, P.O. Box 3005, Framingham MA 01701.* Talk-in on 147.15 Rptr.

RALEIGH, NC The Raleigh ARS will present its 23rd Hamfest/Computer Fair

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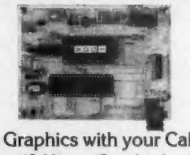

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in the Jim Graham Bldg., NCS Fairgrounds, 8 AM-4 PM. ARRL, MARS, ARES, NTS, DX, and more. Pre-reg. VE Exams/AA4MY, *(919) 847-8512.* Hamfest contact: *Rollin Ransom NF4P, 1421 Parks Vill. Rd., Zebulon NC 27597. Tel. (919) 269-4406.* Talk-in on 146.04/.64.

ROCKFORD, IL An Electronics Expo & Ham Fest will be held 8 AM-1:30 PM by the Rockford ARA. Set-up 5 AM. Location: Rockford Metro Centre, 300 Elm St. Talk-in on 146.01/.61. VE Exams. Flea Market. Ham Gear. Computers, Software. Electronics Commercial Booths. Write to *RARA, P.O. Box 8465, Rockford IL 61126,* or call *Wayne or Fay, (815) 397-6027.*

APR 15

GOOCHLAND, VA The 3rd annual S.M.A.R.T. Swapfest will be held at Goochland County Fairgrounds, RT 522 & 632, 8 AM-3 PM. VE Exams at Noon. Talk-in on 53.06(-) and 147.27(+). Contact *Buddy Travis KA4NNN, (703) 894-0406.* Sponsor: Six Meter A.R. Team.

MUSKEGON, MI The Muskegon County ARES and RACES organization will conduct a HAMFEST and VE Exams at the Pulaski Lodge, 871 Pulaski, off Henry St., 8 AM-2 PM. Talk-in on 146.82 (-). Contact *Greg Hoffman N8RXB, P.O. Box 5313, North Muskegon MI 49445. Tel. (616) 759-8786.*

APR 16

CAMBRIDGE, MA The MIT Electronics Research Soc., the MIT Radio Soc., and the Harvard Wireless Club will hold a Flea Market 9 AM-2 PM at Albany and Main St. Set-up at 7 AM. For info and reservations call *(617) 253-3776.* Mail advance reservations before the 5th to *W1GSL, P.O. Box 397082 MIT BR., Cambridge MA 02139-7082.* Talk-in on 146.52 and 449.725/444.725 pl 2A, W1XM/Rptr.

APR 22

CLARKSTON, WA The 5th Annual Lewis-Clark Hamfest/Computer Fair will be held 8 AM-4 PM at Walla Walla Comm. College (Clarkston Center Campus), West End Bridge St. Flea Market, Seminars, VE Exams. Contact *Ken Anderson KB7IAW, 840 Grelle Dr., Lewiston ID 83501. Tel. (208) 743-9569 days;* or *(208) 743-1074 eves.* Talk-in on 146.36/.96.

TALLADEGA, AL The Talladega RAC will present their "TRACFEST" at the Nat'l Guard Armory. Doors open at 9 AM. VE Exams 10:30 AM. Flea Market. Contact *JT Martin, 4181 Allison Mill Rd., Talladega AL 35160. Tel. (205) 362-0478;* or call *Linda Pettis, (205) 362-5212.*

APR 23

BOOTHWYN, PA The Penn-Del ARC will hold their annual Hamfest 8 AM-2 PM at the Nur Temple on Route 13 in New Castle DE. Setup at 6 AM. Talk-in on 147.225(-) or 224.220/Rptr. Tables by reservation only, with payment to *Penn-Del Hamfest 95, P.O. Box 1964, Boothwyn PA 19061.* VE Exams; registration 9 AM. ARRL Forum 11 AM. Contact *Hal Frantz, (302) 798-7270.*

PITTSFIELD, MA The Northern Berkshire ARC will hold an indoor-outdoor Hamfest/Flea Market at Taconic H.S., Valentine Rd., 8 AM-2 PM. Setup 7 AM. VE Exams 9:30 AM, walk-ins ok. Talk-in on 146.91. Contact *Chuck Lowery NZ1Z, (413) 447-8377.*

SULLIVAN, IL A Hamfest will be held by the Moultrie A.R. Klub at the Moultrie/Douglas County Fairgrounds (near the Arthur H.S.) in Arthur IL. Set-up Sat., Apr. 22nd Noon-4 PM; Sun., 6 AM-8 AM. Payment for Flea Market tables must be received in advance. Send reservations to *M.A.R.K., P.O. Box 91, Lovington IL 61937;* or call *Ralph Zancha WC9V, (217) 873-5287, eves./wkends.* VE Exams by pre-reg. only, 9 AM-Noon. Deadline Apr. 18th. Talk-in on 146.055/.655 and 449.275/444.275.

APR 28

KETTERING, OH The Southwest Ohio Chapter of the Quarter Century Wireless Assn. will hold its 1995 Annual Banquet at Alex's Continental Restaurant. C.O.D. bar at 7 PM; Banquet at 7:30 PM. Program: "Keys to the Success of the Wright Brothers." Reservation deadline Apr 26th. QCWA membership not a requirement. For tickets ($15.00 ea.) make check payable to *Robert L. Dingle, Treas. Chapter 9,* and mail to *1117 Big Hill Rd., Kettering OH 45429-1201.*

APR 30

SACRAMENTO, CA The Student ARC of Calif. State U.-Sacramento will sponsor a Swapmeet on the campus located at US 50 and Howe Ave., 7 AM-Noon. Setup at 6 AM. Talk-in on 145.230 (-dup PL 162.2). For info call *Gary Webbenhurst KC6URB, (916) 381-6602 eves.*

MAY 6

DULUTH, MN The Arrowhead RAC will hold it's annual Swapfest 9 AM-2 PM at the Multi Purpose Bldg. at the Head Of The Lake Fairgrounds, 4700 So. Tower Ave. (HWY 35), in Superior Wisconsin. Ham and Computer Gear. Talk-in on 146.34/.94 MHz. For info or dealer/vendor space, contact *George Mead KA0BUM, 4152 Ugstad Rd., Duluth MN 55811-3620. Tel. (218) 729-6882.*

GREENVILLE, SC The Blue Ridge ARS, Inc. will hold their Hamfest at the Anderson County Fairgrounds, 8 AM-5 PM. Walk-in VE Exams at 12 Noon at Anderson College. Talk-in on 146.01/.61 or 146.22/.82. Contact *Jeff WA4EFT* or *Kay Borke KE4NHX at (803) 967-3284* or e-mail to *borke@aol.com,* or mail to *403 Aster Dr., Simpsonville SC 29681.*

OWEGO, NY Southern Tier ARC will hold the Southern Tier Hamfest 8 AM-4 PM at Marvin Park Fairgrounds, Rte. 17C and Exit 64. They will also host their 36th annual Banquet. VE Exams, Seminars, ARRL Forum, Flea Markets, and more. Talk-in on 146.16/.76 or 146.52/.52. Contact *STARC, P.O. Box*

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MAY 6-7

ABILENE, TX The Key City ARC will sponsor the ARRL West Texas Section Conv. and Hamfest at the Abilene Civic Center from 8 AM-5 PM Sat., and from 9 AM-2 PM Sun. VE Exams. Pre-reg. for tables before May 2nd. Talk-in on 146.160/.760. Contact *Peg Richard KA4UPA, 1442 Lakeside Dr., Abilene TX 79602. Tel. (915) 672-8889.*

MAY 7

BEMIDJI, MN The Paul Bunyan ARC of Bemidji will hold its annual Hamfest 8 AM-3:30 PM at the Bemidji Eagles Club. VE Exams: Contact *Gurnee Bridgmen W9NT, (218) 243-2002.* Flea Market: Contact *Dave Peterson N0QHL, (218) 751-2314* or *George Welte N0WBU, (218) 751-2931.* Talk-in on 146.13/.73.

WARMINSTER, PA The 21st annual Hamfest of the Warminster ARC will be held at the Middletown Grange Fairgrounds, Penns Park Rd., Wrightstown PA. Setup at 6 AM. Open to the public at 7 AM. Talk-in on 147.69/.09 Rptr. and 146.52 simplex. VE Exams at 11 AM. Pre-reg. at 10:30 AM; bring original and copy of present licence and/or certificates of successful completion (if any), two forms of ID, and $5.95 exam fee. Novice class exams are free. Contact *Woody Woodside N6XES, 665 St. Davids Ave., Warminster PA 18974. Tel. (215) 672-8482, 9 AM-9 PM.*

YONKERS, NY A Giant Electronic Flea Market will be held at Lincoln H.S., Kneeland Ave., 9 AM-3 PM. Setups at 7 AM. Sponsor: Metro 70cm Network. VE Exams. For registrations, call *Otto Supliski WB2SLQ, (914) 969-1053.* Talk-in on 440.425 MHz PL 156.7; 223.760 MHz PL 67.0; 146.910 Hz; and 443.350 MHz PL 156.7. Mail paid reservations to *Metro 70 CM Network, 53 Hayward St., Yonkers NY 10704.*

SPECIAL EVENT STATIONS

APR 6-7

DANBURY, CT The 1995 Connecticut QSO Party will be sponsored by the Candlewood ARA, 2000Z May 6th-2000Z May 7th, with a rest period 0400Z-1200Z. CW: 40 kHz up from lower band edges; Novices 25 kHz up from low end. Phone: 1.860, 3.915, 7.280, 14.280, 21.380, 28.380. VHF: 50.150, 144.200, 146.580. For operating rules write with SASE to *CARA, P.O. Box 3441, Danbury CT 06813-3441, USA.*

APR 8-9

CALIFORNIA D.O.T. As part of the Dept. of Transportation's Centennial (1895-1995) events, volunteer members of Headquarters and the 12 District Caltrans Auxiliary Radio System (CARS) Stations, using various call signs, will be operating from 1600Z-0100Z Apr. 8-9. Operations will be in the General portion of the 10, 15, 20, and 75m bands and Novice/General of the 40m band. 2 meter voice contacts on 146.52 simplex, and packet on 145.05 MHz. A commemorative QSL card, with special postal stamp cancellation will be available for contacts made. For info, call *Carol Dulay N6WCV, (916) 654-8884.*

APR 12-13 & 15

HYDE PARK, NY The Franklin D. Roosevelt Presidential Library, in commemoration of the 50th Anniversary of the death of President Roosevelt, is pleased to announce that the Poughkeepsie ARC will set up a working internat'l radio station and historical exhibit at the presidential library in Hyde Park NY. Operations will commence on Wed. Apr. 12th at 1300Z and continue until Apr. 13th at 0100Z. Operations will also be on Apr. 15th 1300Z-2100Z. Station W2CVT is planning to operate on or near the following frequencies (MHz): 7.045, 7.175, 14.045, 14.245, 21.045, 21.310, 146.550, and on the YCCC Packet Cluster. For a certificate and QSL, SASE to *Herbert Sweet, 6 Covey Rd., Hyde Park NY 12538, USA.*

APR 17

SOMERSET, PA The Somerset County ARC will operate Station NJ3T from the Somerset County PA Courthouse, in celebration of the founding of Somerset County 200 years ago. Operations will be from 10 AM-5 PM. Listen for them on the lower 50 kHz of the General class phone bands on 40m 10 AM-1 PM; and 20m 1 PM-5 PM; also 14.105 Packet the entire time. For a QSL card, send QSL and SASE to *James Crowley NJ3T, RD. 5, Somerset PA 15501, USA.*

APR 21-22

KIMBERLING CITY, MO The Kimberling ARC will operate NQ0G 1600Z-2100Z on the lower portions of the 10, 20, and 40m bands. Their CW station will be on 14030-40 and 7125-50 Apr. 21st and 22nd, to celebrate the Inauguration of Kenny Rogers SHOWBOAT, the "Branson Belle." For a certificate, send an SASE to *KARC, P.O. Box 1171, Kimberling City MO 65686, USA.*

APR 22

BELLEVUE, NE The Bellevue ARC will operate W0WYV from 1100Z-2300Z to celebrate the 35th Anniversary of the founding of the Club. SSB operation will be in the lower phone portion of the General 40, 20, and 17m bands, and if propagation permits, in the Novice portion of the 10m phone subband. CW operation will be in the Novice portion of the 40m band. For an unfolded certificate, send your QSL card with contact number and a large 9" x 12" SASE, to *Bellevue ARC, c/o Larry Bailey W0PYA, 1110 Lincoln Rd., Bellevue NE 68005, USA.*

CORWALL, ENGLAND In celebration of Marconi's birthday, the Cornish RAC will sponser over 25 SE Stations representing the locations of early Marconi experiments and transmitting stations, including: CT1TGM, DA0IMD, EI2IMD, EI4IMD, and many more. There will be a certificate for working 12 stations. For more details, contact *G4USB@GB4AKE.#44.GBR.EU* or the *Cornish R.A.C., Box 100, Truro TR1 1RX, Cornwall, England.*

APR 22-23

TULSA, OK The Tulsa ARC will sponsor the Route 66 QSO Party by operating Station W5OK in celebration of the heritage of Route 66. Operation will be from Ollie's Restaurant, the site of the first oil well in Tulsa. W5OK will operate 1800Z Apr. 22nd-1800Z Apr. 23rd. Phone: lower 50 kHz of the General 15, 20, 40, and 80m subbands and the Novice 10m subband. There will also be a 2m SSB station. CW: lower 25 kHz of the General 20, 40, and 80m subbands and the Novice 15m subband. For a certificate, send QSL and a 9" x 12" SASE to *Tulsa ARC, P.O. Box 4283, Tulsa OK 74159, USA.*

APR 28-29

THOMASVILLE, GA Station W4UCJ will be operated by the Thomasville ARC, 1700Z-2300Z Apr. 28th, and 1100Z-2000Z Apr. 29th, to commemorate the 74th annual Rose Festival. Operation will be in the lower portion of the General 80, 40, 20, and 15m phone subbands, and the Novice 10m phone subband. For a certificate, send QSL and a 9" x 12" SASE to *TARC/Rose Festival Station, P.O. Box 251, Thomasville GA 31799, USA.*

APR 28-30

DAYTON, OH Special Event Station W8BI/8 will operate from the Dayton Hamvention Flea Market. Operating hours are: Fri., Apr. 28th, 1300 UTC-2300 UTC; Sat., Apr. 29th, 1300 UTC-2200 UTC; Sun., Apr. 30th, 1300 UTC-1700 UTC. Operation will usually be in the General and Novice phone and CW bands, frequencies as band conditions dictate. W8BI/8 QSL's Hams and SWL's 100%. Send a business-size SASE to *W8BI/8, P.O. Box 44, Dayton OH 45401-0044, USA;* or via the bureau.

MAY 6-7

FRAMINGHAM, MA The Framingham ARA will host the 1995 Mass QSO Party 1800Z Sat., May 6th-0400Z Sun., May 7th; and 1100Z-2100Z Sun., May 7th. Frequencies: Any authorized amateur band except 10, 18, and 24 MHz. CW: 1810, 3550, 7050, 14050, 21050 and 28050. SSB: 1850, 3890, 7290, 14270, 21390, 28390. Novice: 3705, 7130, 21130 and 28130. For full copy of QSO Party rules, send an SASE to *FARA, P.O. Box 3005, Framingham MA 01701, USA.* Packet address *KA1USL @K1UGM* or e-mail *baymw@aol.com).*

MAY 8

SAN FRANCISCO, CA The USS Pampanito, a World War II Balao class submarine, now a Nat'l. Historic Landmark permanently moored in San Francisco, will be the site of a Special Event Station commemorating the 50th Anniversary of VE Day. The call used for the event will be KM6TN/NJVT. NJVT was the radio call assigned to the Pampanito during her years of active service. Personalized certificates will be sent to all confirmed contacts. Operations will be in the lower portion of the General class phone bands, 0000Z-2359Z. The radio crew of the Pampanito will appreciate receiving QSL cards. Mailing instructions will accompany your certificate.

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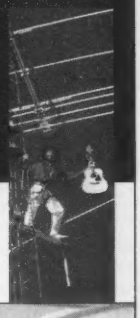

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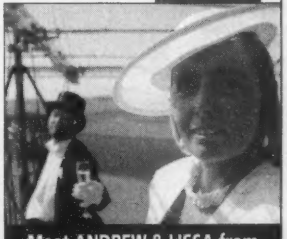

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The suggested retail price for the IC-2000H is $430. For more information visit your favorite dealer or contact *Icom America, Inc., 2380-116th Ave. N.E., Bellevue, WA 98004; (206) 454-8155.* Or circle Reader Service No. 201.

QUANTICS

Quantics has introduced a low cost digital signal processor (DSP) kit for amateur use: the DSP-3. This kit incorporates many suggestions and requests made by users of the original W9GR DSP-1 kit. The popular DSP-1 has been built by thousands of amateurs.

The new DSP-3 kit has 18 DSP functions selectable by a rotary switch, including various combinations of noise (QRN) reduction and heterodyne removal (automatic notch filtering), a DTMF tone decoder with memory, seven tunable CW filters, and various filters for FSK, SSTV, and narrow SSB. A 13-bit converter chip provides the wide dynamic range necessary to filter out weak signals amidst strong QRM.

The DSP-3 kit is priced at $149, and the optional metal cabinet is $19. (California residents add sales tax.) Shipping and handling is $7 in the USA and Canada. For more information contact *Quantics, P.O. Box 2163, Nevada City, CA 95959-2163.* Or circle Reader Service No. 204.

S & S CABLE

Amateurs who like to make their own wire antennas can really appreciate a high quality copper wire that is so flexible you could use it to lace your shoes. S & S Cable has introduced this new antenna wire, designed specifically for high efficiency and ease of installation. This #12 gauge pure copper 413-strand "rope lay" is essentially wire rope specially made for extreme flexibility and resistance to kinking.

This new product offers lower resistance, larger skin surface area, and greater mechanical strength than all the standard wire previously offered. Pure copper will never rust and is nearly impervious to extreme weather. The 413-strand rope lay cannot kink and stretches only 0.2% under a 150 LB test, which would cause only a 2.77° change in a 133' 80 meter dipole, or a 6 kHz change in resonance.

To receive a free sample of the #12 gauge, 413-strand wire rope antenna wire, send an SASE with two units of postage to the address shown. For more information contact *S & S Cable Co., 9010 Forbes Ave., Northridge, CA 91343; (818) 995-0803.* Or circle Reader Service No. 207.

CONNECT SYSTEMS

Connect Systems has unveiled a new model communications decoder which decodes and displays 50 CTCSS codes, 104 DCS codes and all 16 DTMF digits. Model CD-2 can be used in conjunction with scanners, communication receivers, and service monitors to decode the on-the-air communications codes.

In addition to the data on the LED panel, all decoded data is available on the RS-232 serial port. An optional PC compatible software applications program (CD-2P) allows you to view all decoded data on your computer and also acquire time, dates, and hits per CTCSS or DCS code plus usage graphs. DTMF characters are decoded in strings up to 128 characters in length.

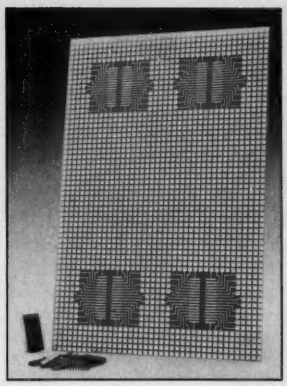
For more information contact *Connect Systems, Inc., 2259 Portola Road, Ventura, CA 93003.* Or circle Reader Service No. 208.

ECODE SYSTEMS

Surfboard is a unique surface mount prototyping board being introduced by ECode Systems. Surfboards offer variable size SIOC pads for design and prototyping flexibility. The unique pad layout allows easy and reliable mounting of both wide (400 mil) and narrow (300 mil) body SIOC styles while accommodating up to 32 pins.

The 100 mil matrix of 80 mil squares is specifically designed to permit chip resistors, capacitors, inductors, SOT style semiconductors and even DIP packages to be mounted with ease.

Surfboard is made in the USA to exacting standards and utilizes the highest quality components such as FR4 (Fiberglas epoxy laminate) and solder plating over 1-ounce copper on both sides. Single units are priced at $19.95 with quantity discounts available. For more information contact *ECode Systems, Inc., 7050 North Wilder Road, Phoenix, AZ 85021; (602) 870-8063, FAX (602) 371-8736.* Or circle Reader Service No. 202.



SIRIO

Sirio Antenna of Milan, Italy—long known throughout Europe for its fine communications antennas, is now being introduced to the North American market by Electronic Distributors. With a very wide range of antenna products for the radio amateur as well as for virtually every radio service, this manufacturer is renowned for excellent engineering, high caliber construction, and attention to detail.

A full-color brochure is now available. For more information please visit your favorite dealer or contact *EDCO, 325 Mill Street NE, Vienna, VA 22180; (703) 938-8105, FAX (703) 938-4525.* Or circle Reader Service No. 205.

CONTACT EAST

The new 1995 catalog is now available free from Contact East, featuring test equipment, tools, and supplies. This 144-page issue is packed with hundreds of new test instruments and tools for amateurs and others. Featured are quality products from brand name manufacturers for testing, repairing, and assembling electronic equipment.

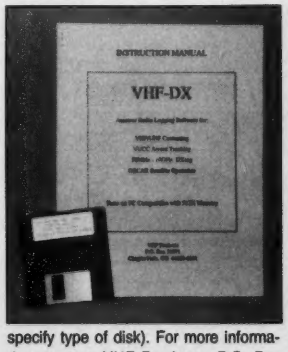
Product highlights include new DMMs and accessories, certification for Fluke multimeters, soldering tools, custom tool kits, EPROM programmers power supplies, ELF meters, adhesives, hand tools, workbenches, and much more.

All products are fully guaranteed and orders placed by 4 PM are shipped by 5 PM. To receive your free catalog contact *Contact East, Inc., 355 Willow Street South, North Andover, MA 01845-5995; (508) 682-2000.* Or circle Reader Service No. 203.

VHF PRODUCTS

If you are planning to participate in an upcoming VHF contest, a logging program designed specifically for the unique requirements of VHF/UHF operation is now available from VHF Products. "VHF-DX" provides logging and scoring functions for the ARRL VHF/UHF contests, including the Spring Sprints. The program identifies new grids, dupe checks, logs rovers, displays QSO and grid count by band (50 MHz to 10 GHz), and has real time scoring. After the contest, the complete log entry and summary sheet are automatically generated to a disk file or hard copy, ready to submit.

VHF-DX runs on PC compatibles with 512K and includes a program disk and printed instruction manual. The price is $10.95 plus $1 for shipping (please specify type of disk). For more information contact *VHF Products, P.O. Box 23391, Chagrin Falls, OH 44023; (216) 543-2748.* Or circle Reader Service No. 206.



Number 21 on your Feedback card

BARTER 'N' BUY

Turn your old ham and computer gear into cash now. Sure, you can wait for a hamfest to try and dump it, but you know you'll get a far more realistic price if you have it out where 100,000 active ham potential buyers can see it than the few hundred local hams who come by a flea market table. Check your attic, garage, cellar and closet shelves and get cash for your ham and computer gear before it's too old to sell. You know you're not going to use it again, so why leave it for your widow to throw out? That stuff isn't getting any younger!

The 73 Flea Market, Barter 'n' Buy, costs you peanuts (almost)—comes to 35 cents a word for individual (noncommercial) ads and $1.00 a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad.

This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham sure it still works right and maybe you can help make a ham newcomer or retired old timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

Send your ads and payment to the Joyce Bocash, *73 Magazine*, Barter 'n' Buy, 70 Rt. 202N, Peterborough NH 03458 and get set for the phone calls.

The deadline for the June 1995 classified ad section is April 13, 1995.

ALL ABOUT CRYSTAL SETS. Theory and construction of crystal set radios. $9.95 each, ppd USA. Send to: **ALLABOUT BOOKS,** Dept. S, P.O. Box 22366, San Diego CA 92192. BNB200

INCREDIBLE DX SITE for individual or ham club in Northern Virginia. ONE OF A KIND!! Fully furnished 2 bedroom cabin with 40' x 15' deck overlooking Shenandoah Valley. 3.5 acres MOL on top REPEAT on top of Blue Ridge at 2100'. Convenient, easy access, one hour west of DC & Dulles Airport. Half down, will finance balance. Serious Buyers only. **DICK KD4ATB**, 813-347-5444. BNB235

ROMAC RADIO EXCHANGE, a revolutionary new computer on-line service for buying and selling amateur radio equipment. Why wait for weeks or even months to sell and buy equipment. Call today! Free until July 1, 1995. (300 to 14400 baud. 8/N/1.) **1-810-486-4878.** BNB260

KPC-3 TERMINAL PROGRAM User friendly, split screen, scrollback buffer, save & send files easily. User programmable auto connect. SASE for FREE details. $29.95. **ComTreK,** Box 4101, Concord NH 03302-4101. BNB271

QRP TRANSMITTERS—3 watt kits and asembled models for 20M, 30M, or 40M. Fun to build! 2 stamps for "milliwater" infor. **Techsonic**, 32F Plymouth Park, Conshohocken, PA 19428. BNB280

Continued on page 90

Number 22 on your Feedback card

PROPAGATION

Jim Gray W1XU

Jim Gray W1XU
210 East Chateau Circle
Payson AZ 85541

April doesn't appear to offer many really Good (G) days for DX propagation. The best days are likely to be the 9th through 11th, the 20th through 22nd, and the 26th through 28th. The worst days are likely to occur during the first week of the month (see the calendar below). Be particularly alert for some geo-physical upsets around the 1st, 2nd and 3rd. "Keep your powder dry!"

Some recent information from NOAA/SESC (thanks, K6QT) indicates that the bottom of present Sunspot Cycle 22 could occur as early as December 1995 or January 1996 . . . almost a full year earlier than might otherwise be expected. Unexpectedly, as this is written (January), the Solar Flux has jumped up from the low '80s to the mid '90s, but such high numbers are not likely to be sustained. For best results, use the best antennas you can afford, and get used to listening for *weak* DX signals.

10 and 12 Meters

Occasional F2 openings to the Southern Hemisphere during daylight hours. The bands close at sunset.

15 and 17 Meters

Consistent openings to Africa and Latin America, and short skip to about 1,000 miles during daylight. Bands close at sunset or shortly after.

20 Meters

Your best band for DX to all areas of the world between sunrise and well past sunset, and short skip to 2,000 miles during daylight hours.

30 and 40 Meters

Good DX from slightly after local sunset to just before local sunrise. Signals from the east peak between sunset and midnight, and from all other areas between midnight and sunrise. Daytime short skip to 1,000 miles, and nighttime skip to 2,500 miles.

80 and 160 Meters

Good DX from sunset to sunrise on nights of low atmospheric noise, and skip to 2,000 miles or so. Requires vertical transmitting antennas and horizontal (preferably Beverage) antennas for best results on receiving. Little, if any, daylight activity on 160, but some on 80 meters.

Final comments require me to warn of possibly violent weather and other geophysical occurrences centered around the 9th and 10th, and again around the 16th and 17th. Hang on to your hats! As always, check WWV at 18 minutes after any hour for the latest updates on propagation. See you here next month.

APRIL 1995

SUN	MON	TUE	WED	THU	FRI	SAT
						1 P
2 P	3 P-F	4 F-P	5 P	6 P	7 P-F	8 F
9 F-G	10 G	11 G-F	12 F	13 F	14 F	15 F
16 F	17 F	18 F	19 F	20 F-G	21 G	22 G-F
23 F	24 F	25 F	26 F-G	27 G	28 G-F	29 F
30 F						

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
AGENTINA								15	15	15	15	15
AUSTRALIA						40	20	20			15	15
CANAL ZONE	20	40	40	40	40		20	15	15	15	15	20
ENGLAND	40	40	40				20	20	20	20		
HAWAII		20			40	40	20	20				15
INDIA							20	20				
JAPAN							20	20				
MEXICO		40	40	40	40		20	15	15	15	15	
PHILIPPINES							20	20				
PUERTO RICO		40	40	40			20	15	15	15	15	
SOUTH AFRICA									15	15	15	
U.S.S.R.							20	20				
WESTCOAST			80	80	40	40	40	20	20	20		

CENTRAL UNITED STATES TO:

ALASKA	20	20						15				
ARGENTINA										15	15	15
AUSTRALIA	15	20				40	20	20				15
CANAL ZONE	20	20	40	40	40	40			15	15	15	20
ENGLAND		40	40					20	20	20	20	
HAWAII	15	20	20	20	40	40	40					15
INDIA								20	20			
JAPAN								20	20			
MEXICO	20	20	40	40	40	40			15	15	15	20
PHILIPPINES								20	20			
PUERTO RICO	20	20	40	40	40	40			15	15	15	20
SOUTH AFRICA										15	15	20
U.S.S.R.								20	20			

WESTERN UNITED STATES TO:

ALASKA	20	20	20		40	40	40	40				15
ARGENTINA	15	20		40	40	40					15	15
AUSTRALIA		15	20	20			40	40				
CANAL ZONE			20	20	20	20	20	20				15
ENGLAND									20	20		
HAWAII	15	20	20	40	40	40	40					15
INDIA		20	20									
JAPAN	20	20	20			40	40	40			20	20
MEXICO			20	20	20	20	20					15
PHILIPPINES	15						40		20			
PUERTO RICO			20	20	20	20	20	20				15
SOUTH AFRICA										15	15	
U.S.S.R.									20			
EAST COAST		80	80	40	40	40	40	20	20	20		

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CIRCLE 164 ON READER SERVICE CARD

BARTER 'N' BUY

Continued from page 89

COMMODORE 64 REPAIR. Fast turn around. **SOUTHERN TECHNOLOGIES AMATEUR RADIO,** 10715 SW 190th Street #9, Miami FL 33157. (305)238-3327. BNB295

WANTED: Electron Tubes, ICS, Semiconductors. **ASTRAL,** P.O. Box 707ST, Linden NJ 07036. Call (800)666-8467. BNB307

KENWOOD AUTHORIZED REPAIR. Also ICOM, Yaesu. **GROTON ELECTRONICS,** Box 379, Groton MA 01450. (508)448-3322. BNB310

UNIQUE INDOOR/OUTDOOR ANTENNA gives 30 dB gain on 160m-10m. Plans: $6.95. **BOB CHRISTIE AA2KE,** 215-28 Spencer Ave., Queens Village NY 11427. BNB319

NOW ON 80 METERS! New, knob-tuned w/digital display, synthesized QRP transceiver. Complete kit only $199.95. S&H $7.00 (continental US). GUARANTEED TO WORK. For info send SASE: Call/write to order: **S & S ENGINEERING,** 14102 Brown Road, Smithsburg MD 21783; (301)416-0661. BNB334

RCI-2950/2970: New modification manual including Power increase. Clarifier modification. Modulation increase. Operating hints, and more. Parts included. Only $20.00 ppd in U.S. (Missouri residents add $1.15 tax). **SCOTT,** P.O. Box 510408, St., Louis MO 63151-0408. (314)846-0252. Money Orders or C.O.D. BNB340

HR2510, RCI2950, CONNEX 3300, COBRA 148, GALAXY SATURN, plus many more kits to increase your modulation, $19.95. **(800)536-0109.** BNB350

QSL CARDS — Standard and custom. Your ideas or ours. Excellent quality. Foil stamping available. Many designs and type styles. Catalog and samples $1.00 refundable. **WILKINS,** Dept. A, Box 787, Atascadero CA 93423. BNB370

WANTED Gunn oscillator/feedhorn ant. sets. **501-931-5682** after 8:00 p.m. BNB377

IT'S BACK! The return of the HW-8 Handbook! Second printing. Modifications for the Heath QRP rigs. First class mail $11. DX add $4 for air mail shipping. **Mike Bryce, WB8VGE,** 2225 Mayflower NW, Massillon OH 44647. BNB404

ASTRON power supply, brand-new w/warranty, RS20M $95, RS35M $135, RS50M $195. Call for other models. **818-286-0118.** BNB411

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types of duplexers. Included is theory of operation, detailed diagrams and much more. Send $9.95 plus $2.50 s&h to **RGM PUBLICATIONS**, 533 Main Street, Hillsboro NM 88042. For faster service using a major credit card call (505)895-5333 and order today. 30 day money back guarantee. BNB635

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HAM RADIO REPAIR- All makes and models. Fast, Professional Service. **AFFORDABLE ELECTRONIC REPAIR,** 7110 E. Thomas Rd., Scottsdale AZ 85251. (602)945-3908. BNB700

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MINIATURE POLICE RADAR TRANSMITTER One mile range, $41 assembled, $31.00 kit. 9025 Coldwater Rd. Bldg. 100A, Fort Wayne IN 46825. BNB719B

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SERIOUS ABOUT SOLAR POWER? The PVSP starter kit comes with a 32 watt Solarex VLX panel and a ten amp Sunlogic charge controller. Special introductory price $275 plus $7 shipping. **SUNLIGHT ENERGY SYSTEMS,** 2225 Mayflower NW, Massillon OH 44647. BNB774

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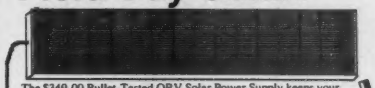

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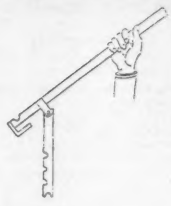
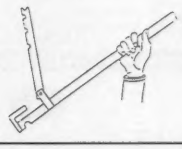


To Disassemble Tower Units



To Assemble Tower Units

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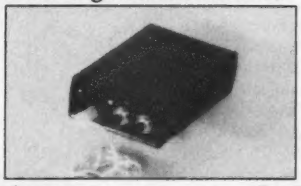

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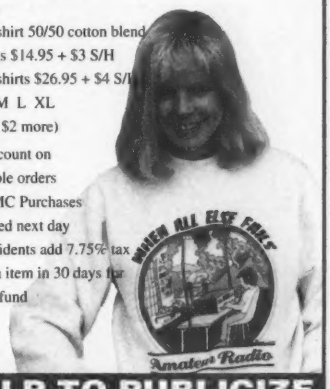

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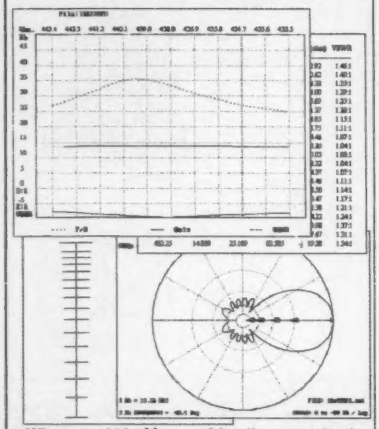

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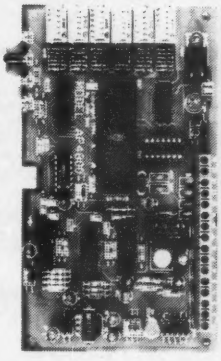

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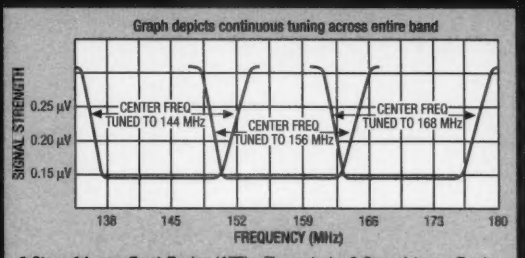

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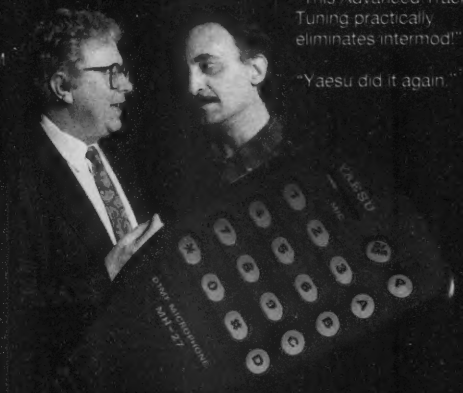

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